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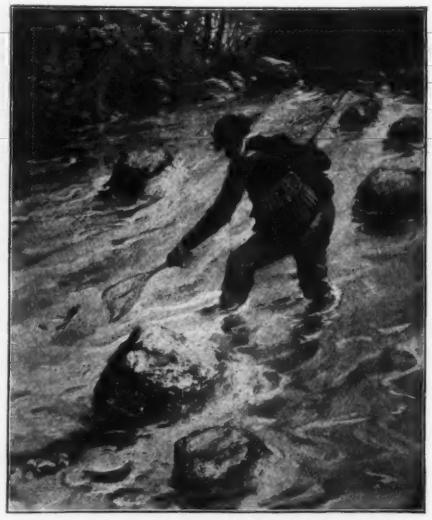

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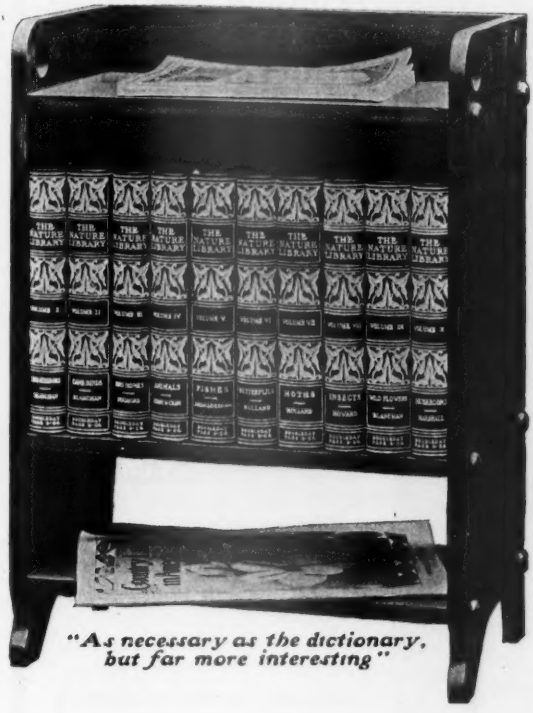

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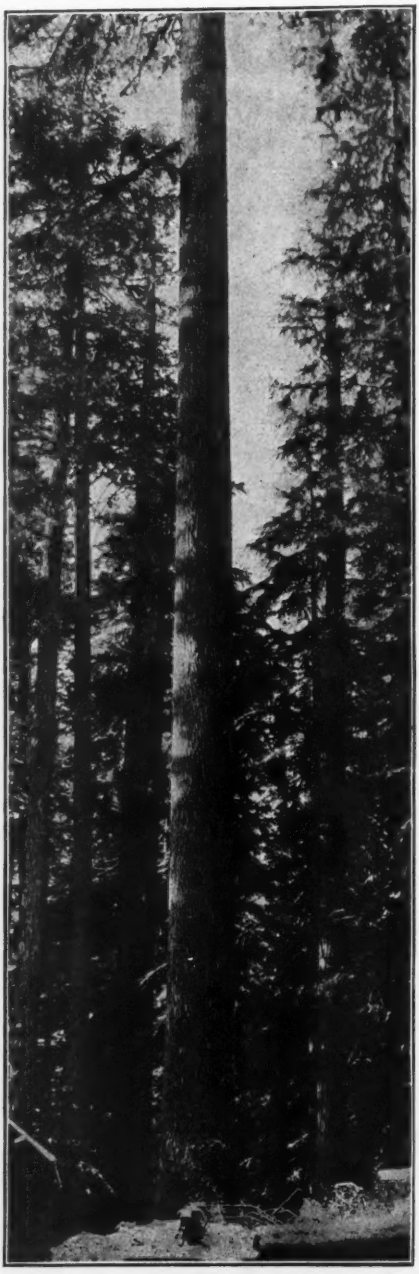

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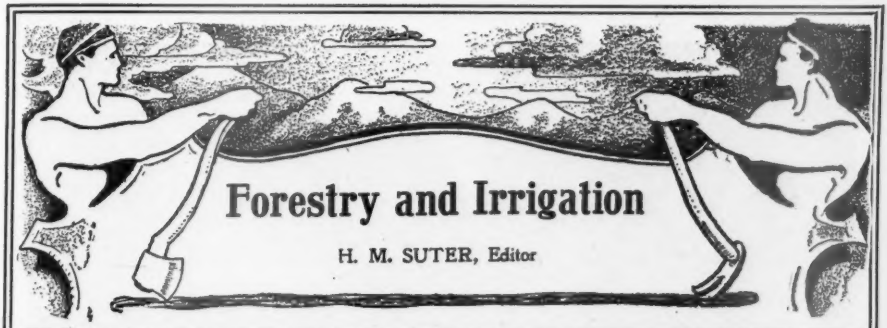

Forestry and Irrigation

H. M. SUTER, Editor

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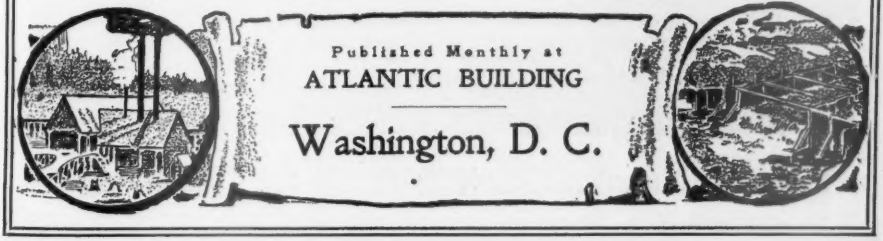

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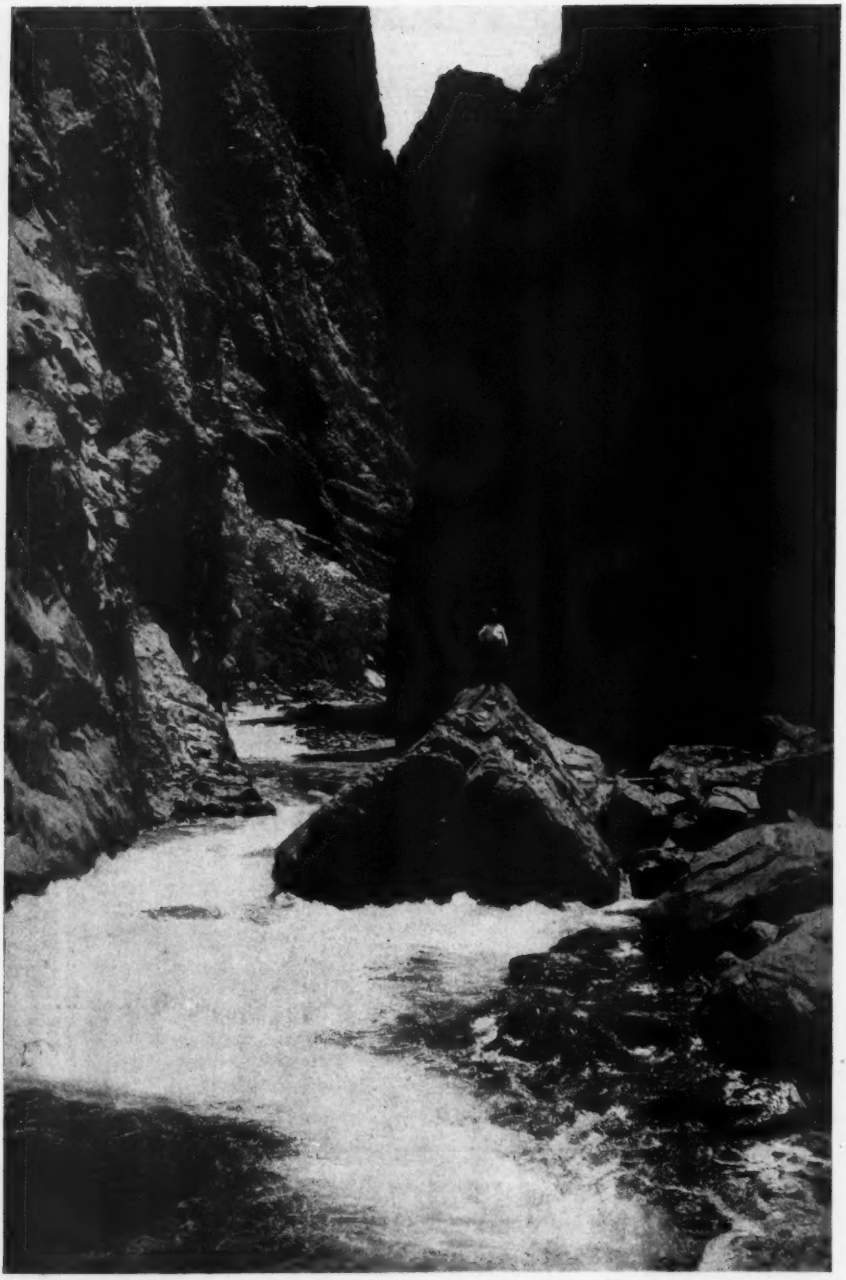

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Forestry and Irrigation.

VOL. X. JULY, 1904. No. 7.

NEWS AND NOTES.

Forest Fire Record. Newspaper reports indicate that the forest fires mentioned as prevalent in northern Minnesota and Wisconsin in last month's FORESTRY AND IRRIGATION have become inactive, principally on account of heavy rains throughout the threatened territory. These fires had been steadily burning for several weeks, and the losses, while not large, have been quite severe to a number of firms in the burned section. In California intense heat and long-continued drouth were the agencies that contributed toward the starting of several forest and grain fires, actively assisted by the omnipresent locomotive spark in most cases. On June 13 a destructive blaze was reported on the Tejon Ranch, about 50 miles from Bakersville, Cal., but it is stated that the losses comprise grain and feed rather than timber. Similar fires occurred in the Tehachapi Mountains near Bealville, with comparatively little damage to timber. Grain fires have been frequent and in some cases entailed severe losses, especially near Honcut, Butte county, Dunnigan, Yolo county, and in Colusa county.

Logging firms and lumbermen generally suffered considerable loss through forest fires distributed throughout Washington. The state has a new fire law, providing severe penalties for non-observance of certain safety regulations, and strong effort is being made by the authorities to secure its rigid observance. The losses to date, says the Seattle *Post-Intelligencer*, are estimated to be not far from $350,000, $150,000 of which is estimated to have been lost through the destruction of timber and lumbering outfits by forest fires in Snohomish county. No further danger is at present apprehended, however, as it is thought that the excessive rains of recent date will have effectually extinguished all signs of fire. The King County Commissioners, who are empowered to act as an *ex officio* Board of Deputy State Forest Fire Wardens, have issued the following warning to the public, together with rules governing the deputy wardens, which will be rigidly enforced during the next three months:

"Any person, firm, or corporation firing or burning any slashing or chopping during the close season without first obtaining permission from the forest fire warden of King county will be prosecuted as provided by law. Before any permission will be granted the applicant must give notice to all owners, tenants, agents, or representatives of adjoining lands, giving the time and place of the proposed burning, and on presentation of proof that such notice has been given permission will be granted after the expiration of three days.

"The forest fire warden shall inspect all logging engines, locomotives, and farm engines, and see that they are properly equipped with spark-arresters as provided by law and report any neglect to the prosecuting attorney."

Water Power Survey. The appropriation of $1,500 recently made by the New York State Legislature for coöperative hydrographic work with the United States Geological Survey will be used in maintaining records of the rise and fall, the ordinary outflow, floods, and drouths of many streams in the state. By means of these records it is possible to determine in specific cases the water supply

available for canals, public water systems, and water power. The conditions of streams in more than fifty places in the state is regularly reported.

The work has gradually grown until there is at present hardly a section of the state in which some river is not systematically measured. The list includes Chemung, Allegheny, Susquehanna, Chenango, Catskill, Delaware, Hudson, Mohawk, Saranac, Oswegatchie, Genesee, Oneida, Seneca, Oswego, and Black rivers, and their most important branches. The developed water power of these streams amounts to nearly 300,000 horse power, and they afford an almost unlimited amount of undeveloped power.

Mr. Robert E. Horton, hydrographer, of Utica, N. Y., has charge of the work.

Reclamation Engineers. From September 15 to 18, 1903, a conference of the engineers of the Reclamation Service was held at Ogden, Utah. At the time of this meeting the Reclamation Service had been in active operation for over a year and projects in each state had reached a point at which their relative merits demanded consideration. It was therefore deemed advisable to bring the principal engineers together, in order to discuss somewhat informally the methods and results of work. The eleventh irrigation congress was in session then at Ogden, and delegates were in attendance from the thirteen states and three territories named in the reclamation law, as well as from Texas and the country farther east. The engineers of the Reclamation Service were thus enabled to meet public men and others who are interested in the work of irrigation and to exchange views freely with them. The proceedings of this conference of reclamation engineers, compiled by Mr. F. H. Newell, chief engineer, have been recently published by the United States Geological Survey as No. 93 of its series of Water Supply and Irrigation Papers, a volume of about 350 pages filled with valuable data. Besides the purely technical discussions and addresses, the paper includes several interesting speeches made to the engineers by various governors, senators, and other prominent people. It is published for gratuitous distribution, and may be obtained by application to the Director of the United States Geological Survey, Washington, D. C.

Forest Reserve Personals. David H. Hunsecker, who has been employed as a first-class ranger on the Lewis and Clarke Forest Reserve, has resigned.

Charles F. Cooley has been appointed forest supervisor of the Grantsville Forest Reserve, recently created.

Three additional rangers have been appointed to serve on the Fish Lake (Utah) Forest Reserve under Forest Supervisor C. D. Balle. Considerable territory has been recently added to this reserve.

The headquarters of the supervisor of the Wichita Forest Reserve in Oklahoma has been changed from Orana to Cache.

Supervisor R. C. McClure has been off duty attending his daughter, who is seriously ill at Santa Fé, New Mexico.

Forest Ranger John M. Simpson has been transferred from the Pikes Peak Forest Reserve to serve as first-class ranger on the Pecos River Forest Reserve, New Mexico.

Thomas F. Meagher, who has been serving as forest ranger on the Gila River Forest Reserve, has been transferred to the Santa Catalina Forest Reserve and promoted to forest supervisor of the latter reserve.

Intensified Farming. A recent editorial in the San Francisco *Chronicle* on "Intensified Farming" is worth reprinting. It calls attention to a matter that deserves the close attention of the farmer in humid areas as well as the regions where irrigation is practiced.

"There is something foreshadowing the future in a little story that has come from Fort Pierre recently. It tells of old ranchers in that region who are farming or gardening in patches of from five to seventy-five acres this year.

They report their corn, oats, and garden stuff to be in fine condition. One reports a wonderfully productive garden, another a good stand of alfalfa—only five acres of it—and so on. The story is one of intensified and diversified farming.

"Soon we shall find the entire West taking up the idea, and with irrigation it will be not only practicable, but highly profitable. The exhaustion of our non-arid public domain compels the settlement of the remaining portion, and there must be irrigation before there can be successful settlement. At the same time irrigation makes intensified farming profitable, for under irrigation there is often more productiveness in forty acres than there is in a whole section where the farmer must depend upon the weather and stand total or partial crop losses two years in five.

"If there is a tendency to intensive farming where there is no irrigation, it is safe to predict that not many years will elapse before the range country is broken up into irrigated farms of a comparatively few acres each wherever irrigation is possible, and Congress can hasten the day by turning a deaf ear to the cattle kings and timber barons and legislating in the interests of the plain people, who are anxious to make homes for themselves.

"Congress has fought shy of this question of preserving the remaining fragment of public domain for the people, but public opinion will surely force a repeal of the laws making monopoly possible and small individual proprietorship impracticable before all the public land has been given to the 'barons.'"

Forest Progress in Indiana. The recent inspection of Indiana's forest reserve in Clark county has brought about some very interesting facts in regard to the work that has been done there and regarding work that is laid out for the coming few months.

When the board, the members of which are President F. C. Carson of Michigan City, Albert Lieber of Indianapolis, Stanley Coulter of Lafayette, John Cochran of Indianapolis, and Secretary W. H. Freeman of Indianapolis, visited the reserve last Tuesday they were, with the exception of Mr. Freeman, greatly surprised at the work that had been done. Mr. Freeman, by close economy and careful attention to each detail of the work, and personal inspection of the land, has succeeded in transforming a part of Hoosier wilds into a park.

Last year at this time the land was in as dilapidated a condition as old fences, buildings, underbrush, and none-too-careful attention could make it. At that time there were no roads through the reserve. At the present time the reserve is carefully cleared, and many trees have been planted over ground that was formerly given to crops of corn and such truck as was grown in that section of the country. Winding among the hills are roads, by which the inspection party was able to see almost all the improvements from a carriage. The buildings which were formerly on the land have been removed and all parts of the reserve are now ready for the work of planting and attending the young trees.

The planting of 10,000 white pines on the knobs was completed, and everything is now practically ready to work on the newly cleared and prepared ground. In speaking of the work which will next be taken up, Mr. Freeman states that there are 250 acres of the reserve which will be worked over from September to December. This land will be planted with hardwood trees, including walnut, hickory, beech, and ash, with some poplar and similar trees. The final details in preparing this ground will be taken up with the beginning of this week. The patrolling of the land has already commenced and will continue during the summer and fall.

To the Clark County sportsmen the reserve offers a tempting hunting ground. Squirrels are already finding a safe retreat and plenty of quail and other feathered game are becoming plentiful in the woods. Although the law does not permit the shooting of squirrels until August, they are already being killed in the south part of the state, and it is the duty of the patrol to see that none of the little animals are molested on the reserve.

Michigan Students' Trip. The seniors in the forest courses at the Michigan State Agricultural College recently made a trip to the pine lands in the northeastern part of the lower peninsula, visiting several wood-working factories en route, free transportation having been furnished north from Bay City by a railroad company interested in forestry.

Huge Irrigation Enterprise. Announcement has been made that work will be begun immediately on the completion of the water system of the California Mountain Water Company, of which John D. Spreckels, of San Francisco, is president. This system already consists of two large reservoirs, the Lower Otay and the Upper Otay dams, which impound many billions of gallons of water, and the work remaining to be done consists of constructing the Barrett dam at Morena, the building of the conduit to carry the water from there to the Lower Otay dam, and the laying of the pipe line from Bonita to this city.

The cost of the work now to be undertaken will be more than $2,000,000. The watershed tributary to the Barrett reservoir has the greatest rainfall of any section south of San Francisco, and with the system completed there will be ample water supply for a city several times the size of San Diego. The average rainfall in that section is about forty inches a year. Thousands of acres of agricultural land will be brought under irrigation, and the towns of National City, Chula Vista, and Otay will be supplied.

The announcement that this work is to go forward at once and as rapidly as possible is regarded as one of the greatest events in the development of San Diego.

Nebraska Forest Students. In the University of Nebraska about thirty men have been in the courses in foresty the past year, a very good showing for the second year of its establishment. At the recent commencement three men completed the forestry work and were graduated with the degree of Bachelor of Science (in forestry). These men had been taking work in other scientific courses, and on the establishment of the forestry courses were transferred to the latter, which they completed in two years. The full course is four years in length, and entrance to the freshman class requires the same preparation as for the scientific or literary courses. The students in advanced classes in forestry in the University of Nebraska spent a month this spring on the Dismal River Forest Reserve, at work under the direction of the Bureau of Foresty officers. They helped in the work of planting the sand hills with seedling pine trees.

Benefit of Hydrographic Records. The parable of the sower is applicable to all educational work. Much of the mission of the great departments maintained by the government, especially the scientific bureaus, is educational in its nature. The government is in the position of a progressive and ambitious instructor in a modern college, who, surrounded by every laboratory and library facility, spends part of his time in making original investigations and part in communicating to his pupils the results of his studies. The seed he sows falls on all kinds of soil, but, however poor the ground, it is sure to bring forth fruit in some measure, if there is life in the kernels that he sows. There is great variation in the returns from the different kinds of educational work prosecuted by the government. The ultimate value of much of it can be determined only after the lapse of many years, but some of it seems to bear fruit a hundred fold from the very start. An instance of this is seen in the results that have followed the hydrographic work of the U. S. Geological Survey in many quarters. The cases in which it has been a benefit to the one State of Colorado, for example, are numerous and interesting.

None of the irrigation work contemplated by the government would, ordinarily, be possible without long delay,

were it not for the hydrographic data accumulated by the Survey during many years of observation and measurement. In addition to that, the work of private individuals is constantly facilitated by the same records. No large engineering enterprises are now undertaken without reference to the Survey's records concerning the supply of water available at the chosen site. The South Platte Land and Reservoir Company, which has under way canals and reservoirs that probably aggregate $500,000 in value, has established stations at Orchard and Kersey, Colorado, because of the superior hydrographic advantages offered by those localities. The choice of those points is directly traceable to the data compiled by the Survey. Equally important is the fact that projects that would have resulted disastrously have in numerous cases been abandoned after a study of Survey records that threw light on the probable outcome. Data concerning the flow of water on the Arkansas and South Platte rivers prevented the expenditure of great sums of money on the state canal in the first instance, and upon the Pawnee Pass reservoir project in the second.

Survey data seem to be in great demand as unimpeachable testimony in the legal controversies that have arisen in this state in regard to irrigation matters. A most notable instance is the case of the Colorado and Southern Railroad *vs.* The Denver Union Water Company, in which the sum of $100,000 was involved.

Data obtained by the Survey in regard to the amount of water power available at certain places have influenced the plans of the Glenwood Springs Light and Power Company, the New Century Light and Power Company, and also proposed power companies on Clear and St. Vrain's creeks. None of these projects has yet been carried to a conclusion, but some of them will undoubtedly be eventually constructed.

Colorado cities seeking a suitable water supply have frequently consulted data obtained by the Survey. In the case of Durango, in southwestern Colorado, the discharge of Florida River was

AN ARTESIAN WELL IN THE WESTERN IRRIGATION COUNTRY.

especially studied in order to ascertain whether a gravity water system would be feasible at that point.

The location of various manufacturing industries has been determined by reports from Survey engineers on the available water supply. Conspicuous instances of this are the construction of the American Beet Sugar Company's plant at Rocky Ford and the erection of the sugar factory at Loveland.

Cutting Trees by Electricity. It is reported in the German press that successful experiments have been made in various forests of France in cutting trees by means of electricity. A platinum wire is heated to a white heat by an electric current and used like a saw. In this manner the tree is felled much easier and quicker than in the old way, no sawdust is produced, and the slight carbonization caused by the hot wire acts as a preservative of the wood. The new method is said to require only one-eighth of the time consumed by the old sawing process.

Salt River Water. Mr. M. O. Leighton, chief of the Hydro-Economic Division of the U. S. Geological Survey, has been making an investigation to determine the quality of water for irrigation in Salt River above Tonto dam, and to ascertain whether the influx of salt is general, or whether it is derived from one or more isolated points.

This information is believed to be important by reason of the fact that if it is found that the source or sources of salt are isolated or local in character, steps might be taken to eliminate them from the river by well-known means determined according to the conditions in each case.

This investigation has been conducted during the period of low water in the river, because at that time the stream contains foreign ingredients in as large a proportion as is likely to be found at any other season, and the results which are arrived at will be typical of the most unfavorable conditions. Deductions made therefrom, therefore, will probably err upon the side of safety by a wide margin.

It was found that the amount of chlorine in Salt River water is very high. At the dam site the results from the main stream were 1,360 parts of chlorine to the million, and at other points upstream for a distance of 53 miles it varied from 1,600 to 1,850 parts. The results obtained prove clearly that the salt in Salt River water is not derived from any definite source or sources, but is carried in by the general influx throughout the region. At the outset it was believed that the greater part of the salt came from what is known as the salt beds and the salt springs which are located along the river some distance below the mouth of Cibicu Creek, where there is an extensive outcrop of sodium chloride and calcium carbonate. It was found, however, that these salt beds have little or no effect upon the salinity of the water, and Mr. Leighton is inclined to believe that the entire country is underlaid by a deposit of which the salt beds are an example, the only difference being that at the salt beds the saline stratum outcrops upon the bank of the river.

The amount of salt found in the water along the entire reach of the portion of the river investigated varies surprisingly little. The influx of fresh water from the various creeks does not affect the amount of salt in the river to any appreciable degree, although tests show little or no salt in their waters, the amounts varying from 10 to 60 parts a million.

Probably the effect of the contributions upon the stream from these tributaries would be more apparent if they carried any considerable amount of water, but at the present time they are very low.

A review of the results of the investigation indicates that the salt in the waters of Salt River is derived from no local sources, and that it would be impossible to change in any relative degree the amount in the stream. Whatever may be done in connection with the improvement of the water of Salt River for irrigation purposes, it will be necessary to accept the water in its original

saline conditions. It is expected that the storage of the flood waters behind the Tonto dam will have an important effect in reducing the amount of salt in the water used for irrigation. To ascertain definitely this fact, a series of periodical salt determinations will be made in the river water at the dam, especially during flood periods. Careful study will also be made of the evaporation in the region of the dam in order to discover what may be expected in the way of concentration during the periods of low water, or when the flow from the reservoir is equal to or greater than that contributed by the drainage area.

From rough preliminary calculations it seems probable that with a reservoir full of flood water containing only a small proportion of salt it would require many months of concentration by evaporation and further contributions of strongly saline water from the contributing basins to produce in the waters of the reservoirs a salinity equal to that now present in the stream.

The waters of Tonto Creek and Verde River are comparatively sweet, and the degree of dilution which will be present will have an important bearing upon the water as it is distributed to the irrigated lands in the Salt River Valley. Calculations in this direction will be made as soon as data with reference to the flow of these streams are collected. These three features contribute the most important factors in determining the effect of the salt in Salt River upon irrigated crops.

Public Lands Commission. Mr. Frederick V. Coville, botanist of the U. S. Department of Agriculture, and Mr. Albert F. Potter, grazing expert of the Bureau of Forestry, are now in the southwest making a careful study of the grazing interests for the information of the Public Lands Commission.

Mr. Coville is giving special attention to the grazing lease systems now being applied to state, railway, and Indian lands, with a view of determining whether or not any of these systems can be applied to the public lands. Along with this work, he is also studying whether by some new system of management the condition of the ranges can be improved.

Mr. Potter's work deals more with present methods of handling live stock on the range and in securing information in regard to the classification of ranges — that is, determining which should be classified as summer and winter ranges, as well as the further division as to which are best suited for cattle or sheep. His work is carried on wholly with a view of determining the more practical means for the control of ranges generally, which is a subject of prime importance to the grazing interests, and one which the Public Lands Commission is going into very thoroughly.

Remarkable Natural Dam. At Marble Falls, Texas, Engineer Thomas U. Taylor, of the U. S. Geological Survey, reports a remarkable natural dam in the course of the Colorado River. The formation of limestone rocks has constructed a dam where a fall of 12 feet has been utilized to pump the water supply for the city.

From the present lake level above the falls to the head of the tail race there is a fall of 16.4 feet; to the end of the tail race, or to the tail-race pond, a fall of 19 feet; to the pond under the highway bridge, a fall of 21.60 feet. A small outlay of money would increase the head fully 5 feet without raising the crest of the dam. From the lake under the bridge to the bend in the river below there is a fall of 12.80 feet, or a total fall from the lake of 35.40 feet, and to a point 1.25 miles below the dam there is a fall of 47 feet.

There are two ways in which the power could be materially increased: (1) By excavating the tail race to the lake under the bridge by cutting it down at the head four and a half feet, which would give an effective head of 21 feet; (2) by raising the crest of the present dam by the cheap construction of a dam on the crest of the present natural dam from 4 to 12 feet, giving a maximum head of 33 feet. The minimum flow found in recent years was 160 second-

feet, which could develop 480-horse power if all the flow were used, with a head of 33 feet. A water power of 600-horse-power capacity could be inaugurated at this place, the only expense being the construction of a tail race and erecting the power plant, and raising the present lake level 12 feet. This would involve the purchase of a small tract of submerged land.

There will certainly be a big demand for the power in the future. Granite Mountain is only 2 miles away, and is right along the tracks of the railway. By combining the water power and the granite industry, a corporation could command the best and most economical manufactured output. Marble Falls offers greater possibilities for water power than any other point in Texas.

Irrigation and Power Development. The great problems in irrigation now being worked out to practical conclusions by the U. S. Reclamation Service involve some features not observed by people generally. Chief of these is the possibility of extensive development of power in connection with the storage of water in large reservoirs or the diversion of streams into canal systems.

Many immense dams are to be built, some of them 200 feet or more in height, and when water for irrigation is drawn from the great artificial lakes so produced, incidentally an enormous amount of water power becomes available. It is proposed to erect power plants at many localities and transmit the power electrically over distances aggregating hundreds of miles to other localities where the power can be utilized for pumping water from deep wells for irrigation and domestic purposes. Thus the water which is impounded in the reservoirs and diverted from the streams is made to perform a double duty, primarily, by its direct application to the irrigation of land, and, incidentally, by furnishing the power for lifting from underground sources additional water supplies.

The construction of these great irrigation works requires the use of much machinery and the transportation of large quantities of materials. Usually this construction work has to be carried on in places remote from railroads and other bases of supplies, where the cost of labor, teams, and fuel is abnormally high. To meet this condition, power is frequently obtained from a stream close at hand by means of temporary dams, power canals, etc., and applied to the work of excavating, quarrying, hoisting, hauling, and lighting. Thus many short electric railroads will be constructed between the great irrigation works and the nearest railroad stations, which will be useful, when the construction work is completed, for affording easy access to the completed works.

Whatever power in excess of that required for pumping purposes is obtainable from the national works of irrigation, it may serve for operating street railways and electric lighting in the communities which have grown up as the result of the government's work in supplying water to lands previously uninhabitable. These great works will, after the lapse of a limited time and upon the return to the government of the money expended on construction, become the property of these communities, and any revenue derived from the sale of power obtained in the process of storing and distributing irrigation water would serve to offset in part the operating expenses of the irrigation system.

Since these reservoirs frequently must be built far up in the mountains near the headwaters of streams, it will often happen that power can be advantageously supplied to adjacent mines, where power is especially valuable on account of the difficulties in transportation of fuel to these inaccessible localities.

On a few of the larger projects—for instance, those contemplating the control of the great Colorado and Snake rivers—the magnitude of the power development possibilities suggests the feasibility of operating considerable portions of the great railroad lines crossing these sections of the country by electric power obtained from water plants built in connection with the great dams required for the control of these mighty rivers.

Nebraska Meeting. The annual summer meeting of the Nebraska Park and Forestry Association was held at York, Nebraska, June 14 and 15. The attendance was not large, but the program was good, and a lively interest was manifested in forest subjects. Frank G. Miller, Chas. A. Scott, and Wm. H. Mast, of the Bureau of Foresty, each presented subjects bearing upon the work the Bureau is doing in that state. A committee was appointed to look into the possibility of securing land in the Pine Ridge region of northwestern Nebraska for a state park and forest. The Pine Ridge country is very picturesque, and in many places there is a good stand of timber, but much of it is being destroyed by indiscriminate cutting. If a few thousand acres of this timber land can be bought at a reasonable price, it is hoped the state legislature may be induced to buy it for the purpose mentioned.

North Dakota Artesian Belt. Chief Engineer Newell, of the Reclamation Service, recently received a letter from the president of the North Dakota Irrigation Congress relating to the development of the artesian basin of North Dakota, and asking that hydrographers be sent to ascertain the possibilities of artesian well development in the western part of the state for the purposes of irrigation.

It is believed by the people of North Dakota that there is a strong artesian basin or flow underlying the whole state which might be touched by wells of various depths.

Under the direction of Engineer N. H. Darton, investigations have been carried on of the underground water resources of the eastern portion of North Dakota, and it is hoped during the coming season provisions can be made for an investigation of the artesian possibilities of the western portion of the state.

It is believed that the main artesian flow west of the Mississippi River in this state lies entirely too deep to be of service either for irrigation or domestic purposes. Small flows appear to be obtainable locally from the Laramie sandstones, but their volume, so far as now known, is too small to give promise of being serviceable for the reclamation of public lands. The importance of this matter, however, is fully appreciated by the Service, and it will be given careful consideration.

Irrigating Indian Lands. The recent action of Congress in passing Senator Bard's amendment to the Indian Bill has put another definite task upon the Reclamation Service. The Secretary of the Interior is now authorized to subdivide and utilize the Indian lands along Colorado River. The reclamation of the country adjacent to what has sometimes been called "the great American Nile" is thus assured.

The plans to irrigate these lands have long been regarded with special favor in southern California. The chambers of commerce in Los Angeles and other cities were indeed nothing loath to urge Congress to take prompt action in the matter.

The passage of Senator Bard's amendment is especially interesting, as it is now possible for the Secretary of the Interior to carry out an agreement made with the Indians years ago, to the effect that their lands might be subdivided and irrigated by a private corporation. Suitable laws were passed, but the company failed to build the works, and the Indians have been waiting for other relief. From time immemorial they have been accustomed to cultivate the lands along the river in spots wet by the natural overflow. These areas have now passed into the hands of the whites. All that is left the Indians is desert land that, without water, is valueless. With water, however, it can be made to produce several crops a year. Under the amendment to the Indian Bill, relief has finally come to the impoverished Indians.

The Secretary of the Interior is now free to build the necessary canals under the terms of the reclamation law, and to allot to each Indian five acres of land with water. He need not wait on any private corporation. As the Indian families average from five to six persons,

this would give them ample lands for their support, judging from the experience of the Mormons in Utah, where the average irrigated farm is less than 30 acres. The lands not utilized by the Indians are to be opened to white settlers who will pay for them. Under the terms of the reclamation law the sale of lands will serve to defray the expenses of the irrigation works, payment being made in ten annual installments. Southern California and adjacent portions of Arizona should be benefited by the influx of settlers which is sure to follow the irrigation of the land.

Eastern Nebraska Timber.

For several seasons the Bureau of Forestry has been making a careful study of the timber resources of Nebraska. This study will be carried still further this summer. The survey in the western portion of the state has been completed, and reports on it are now being prepared. A direct result of the work in western Nebraska has been the establishment of the Dismal River and Niobrara Forest Reserves, comprising some 212,000 acres in the sand hills. These two reserves have been surveyed, and planting operations are under way on the former.

Considerable work has also been done in eastern Nebraska from time to time, and a party under Mr. Frank G. Miller, of the Bureau of Forestry, will continue the investigation the present field season. The territory to be covered includes all that part of the state lying east of the ninety-ninth meridian. Mr. Miller is now in the field making preliminary preparations for the investigation, and his party will follow about July 1. It is expected that the field work will be completed by October 1. The data collected in the meantime and the notes now on file concerning this region will be brought together in one report.

The investigation will include a careful study of both the natural and planted timber. Nebraska is credited with having more than 200,000 acres in forest plantations, by far the larger portion of which lies within the region to be covered by the study. Note will be made of the character of planting done in the past, with a view to determining the most profitable species for future planting in the same localities. A great number of measurements in commercial plantations will be made to get an estimate of the yield in cordwood, posts, ties, poles, etc., that may be expected from a planted grove of a given species in a specified time. The information thus obtained will be of great value to farmers on the plains, since it will give them a basis for judging accurately how much planting they must do to supply their domestic needs, and what kinds of trees will in the long run prove most productive for different purposes.

The study of the natural forest growth will include a classification of the trees and shrubs, together with notes on their distribution. Special attention will be given to the extension of the natural timber areas. Those who have given this question careful thought find striking evidence of the rapid advance of woody growth to new ground. Cases are known where natural timber belts have extended up ravines for two miles in eastern Nebraska within the last thirty years. This tendency is marked throughout the eastern portion of the state. The investigations this summer will give an excellent opportunity for further study of this most important phase of forest extension.

The field party, which will consist of six men, all of whom are college or university graduates and in addition have had special training in forestry, will be outfitted at Lincoln. Two parties of two men each will travel overland by team, and will have special charge of the study and measurements of plantations. A fifth man will be equipped with a saddle horse, and will give his attention more particularly to an examination of the natural timber resources, while Mr. Miller will have general charge of the investigation.

The Bureau of Forestry bespeaks the hearty coöperation of the people of Nebraska in this work, and will greatly appreciate any favors shown the members of the party that will in any way assist them in the prosecution of this study.

HON. JAMES H. ECKELS,

A LEADING FINANCIER AND ONE OF THE STRONGEST ADVOCATES OF NATIONAL IRRIGATION.

ONE of the first of our public men to take an active interest in the reclamation of the arid lands of the West was Hon. James Herron Eckels. As treasurer of the National Irrigation Association, and in many other ways, he has assisted this great cause. Few men of his age have been so long in positions of great responsibility as Mr. Eckels. As a public servant and as a business man he has won general esteem and confidence. He was born in Princeton, Ill., November 22, 1858. He was educated in city public and high schools, graduating in 1876. He graduated from Albany, N. Y., Law School in 1880, practiced law at Ottawa, Ill., from 1881–'93, and was appointed, April 3, 1893, Comptroller of Currency. He is a Democrat, and has made many speeches on the currency question, becoming prominent as a gold-standard advocate. In 1896 he affiliated with the National (gold-standard) Democrats. He remained in office until the end of 1897, becoming, January 1, 1898, president of the Commercial National Bank of Chicago.

OLD EPHRAIM.

WILDERNESS RESERVES.*

BY

PRESIDENT ROOSEVELT.

PART II.

A COUPLE of days after leaving Cottonwood Creek, where we had spent several days, we camped at the Yellowstone Cañon below Tower Falls. Here we saw a second band of mountain sheep, numbering only eight—none of them old rams. We were camped on the west side of the cañon; the sheep had their abode on the opposite side, where they had spent the winter. It has recently been customary among some authorities, especially the English hunters and naturalists who have written of the Asiatic sheep, to speak as if sheep were naturally creatures of the plains rather than mountain climbers. I know nothing of old world sheep, but the Rocky Mountain bighorn is to the full as characteristic a mountain animal, in every sense of the word, as the chamois, and, I think, as the ibex. These sheep were well known to the road-builders, who had spent the winter in the locality. They told me they never went back on the plains, but throughout the winter had spent their days and nights on the top of the cliff and along its face. This cliff was an alternation of sheer precipices and very steep inclines. When coated with ice it would be difficult to imagine an uglier bit of climbing, but throughout the winter, and even in the wildest storms, the sheep had habitually gone down it to drink at the water below. When we first saw them they were lying sunning themselves on the edge of the cañon, where the rolling grassy county behind it broke off into the sheer descent. It was mid-afternoon and they were under some pines. After a while they got up and began to graze, and soon hopped unconcernedly down the side of the cliff until they were half way to the bottom. They then grazed along the sides, and spent some time licking at a place where there was evidently a mineral deposit. Before dark they all lay down again on a steeply inclined jutting spur midway between the top and the bottom of the cañon.

Next morning I thought I would like to see them close up, so I walked down three or four miles below where the cañon ended, crossed the stream, and came up the other side until I got on what was literally the stamping ground of the sheep. Their tracks showed that they had spent their time for many weeks, and probably for all the winter, within a very narrow radius. For perhaps a mile and a half, or two miles at the very outside, they had wandered to and fro on the summit of the cañon, making what was almost a well-beaten path; always very near and usually on the edge of the cliff, and hardly ever going more than a few yards back into the grassy plain-and-hill country. Their tracks and dung covered the ground. They had also evidently descended into the depths of the cañon wherever there was the slightest break or even lowering of the upper line of basalt cliffs. Although mountain sheep often browse in winter, I saw but few traces of browsing here; probably on the sheer cliff side they always got some grazing.

When I spied the band they were lying not far from the spot in which they had lain the day before, and in the same position on the brink of the cañon. They saw me and watched me with interest when I was two hundred yards off, but they let me go up within forty yards and sit down on a large stone to look at them without running off. Most of them were lying down, but a couple were feeding steadily throughout the time I watched them. Suddenly one took the alarm and dashed straight over the cliff,

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the others all following at once. I ran after them to the edge in time to see the last yearling drop off the edge of the basalt cliff and stop short on the sheer slope below, while the stones dislodged by his hoofs rattled down the cañon. They all looked up at me with great interest and then strolled off to the edge of a jutting spur and lay down almost directly underneath me and some fifty yards off. That evening, on my return to camp, we watched the band make its way right down to the river bed, going over places where it did not seem possible a four-footed creature could pass. They halted to graze here and there, and down the worst places they went very fast with great bounds. It was a marvelous exhibition of climbing.

After we had finished this horseback trip we went on sleds and skis to the upper Geyser Basin and the Falls of the Yellowstone. Although it was the third week in April, the snow was still several feet deep, and only thoroughly trained snow horses could have taken the sleighs along, while around the Yellowstone Falls it was possible to move only on snowshoes. There was very little life in those woods. We saw an occasional squirrel, rabbit, or marten, and in the open meadows around the hot waters there were geese and ducks, and now and then a coyote. Around camp Clark crows and Stellar's jays, and occasionally magpies, came to pick at the refuse, and, of course, they were accompanied by the whiskey jacks, with their usual astounding familiarity. At Norris Geyser Basin there was a perfect chorus of bird music from robins, purple finches, juncos, and mountain bluebirds. In the woods there were mountain chickadees and nuthatches of various kinds, together with an occasional woodpecker. In the northern country we had come across a very few blue grouse and ruffed grouse, both as tame as possible. We had seen a pigmy owl no larger than a robin sitting on top of a pine in broad daylight and uttering, at short intervals, a queer, un-owllike cry.

The birds that interested us most were the solitaires, and especially the dippers or waterousels. We were fortunate enough to hear the solitaires sing, not only when perched on trees, but on

MOUNTAIN SHEEP AT CLOSE QUARTERS.

MAGPIES.

the wing, soaring over a great cañon. The dippers are, to my mind, well-nigh the most attractive of all our birds. They stay through the winter in the Yellowstone because the waters are in many places open. We heard them singing cheerfully, their ringing melody having a certain suggestion of the winter wren's. Usually they sang while perched on some rock on the edge or in the middle of the stream, but sometimes on the wing. In the open places the western meadow larks were also uttering their singular, beautiful songs. No bird escaped John Burroughs' eye; no bird note escaped his ear.

On the last day of my stay it was arranged that I should ride down from Mammoth Hot Springs to the town of Gardiner, just outside the park limits, and there make an address at the laying of the corner-stone of the arch by which the main road is to enter the park. Some three thousand people had gathered to attend the ceremonies. A little over a mile from Gardiner we came down out of the hills to the flat plain. From the hills we could see the crowd gathered around the arch waiting for me to come. We put spurs to our horses and cantered rapidly toward the appointed place, and on the way we passed within forty yards of a score of blacktails, which merely moved to one side and looked at us, and within a hundred yards of half a dozen antelope. To any lover of nature it could not help being a delightful thing to see the wild and timid creatures of the wilderness rendered so tame, and their tameness in the immediate neighborhood of Gardiner, on the very edge of the park, spoke volumes for the patriotic good sense of the citizens of Montana. Major Pitcher informed me that both the Montana and Wyoming people were cöoperating with him in zealous fashion to preserve the game and put a stop to poaching. For their attitude in this regard they deserve the cordial thanks of all Americans interested in these great popular playgrounds, where bits of old wilderness scenery and the old wilderness life are to be kept unspoiled for the benefit of

A SILHOUETTE OF BLACKTAIL.

our children's children. Eastern people, and especially eastern sportsmen, need to keep steadily in mind the fact that the westerners who live in the neighborhood of the forest preserves are the men who, in the last resort, will determine whether or not these preserves are to be permanent. They can not in the long run be kept as forest and game reservations unless the settlers roundabout believe in them and heartily support them, and the rights of these settlers must be carefully safeguarded, and they must be shown that the movement is really in their interest. The eastern sportsman who fails to recognize these facts can do little but harm by advocacy of forest reserves.

It was in the interior of the park, at the hotels beside the lake, the falls, and the various geyser basins that we would have seen the bears had the season been late enough, but unfortunately the bears were still for the most part hibernating. We saw two or three tracks, and found one place where a bear had been feeding on a dead elk, but the animals themselves had not yet begun to come about the hotels. Nor were the hotels open. No visitors had previously entered the park in the winter or early spring, the scouts and other employés being the only ones who occasionally traversed it. I was sorry not to see the bears, for the effect of protection upon bear life in the Yellowstone has been one of the phenomena of natural history. Not only have they grown to realize that they are safe, but, being natural scavengers and foul-feeders, they have come to recognize the garbage heaps of the hotels as their special sources of food supply. Throughout the summer months they come to all the hotels in numbers, usually appearing in the late afternoon or evening, and they have become as indifferent to the presence of men as the deer themselves—some of them very much more indifferent. They have now taken their place among the recognized sights of the park, and the tourists are nearly as much interested in them as in the geysers.

It was amusing to read the proclamations addressed to the tourists by the park management, in which they were solemnly warned that the bears were really wild animals, and that they must on no account be either fed or teased. It is curious to think that the descendants of the great grizzlies, which were the dread of the early explorers and hunters, should now be semi-domesticated creatures, boldly hanging around crowded hotels for the sake of what they can pick up, and quite harmless so long as any reasonable precaution is exercised. They are much safer, for instance, than any ordinary bull or stallion, or even ram, and in fact there is no danger from them at all unless they are encouraged to grow too familiar or are in some way molested. Of course among the thousands of tourists there is a percentage of thoughtless and foolish people, and when such people go out in the afternoon to look at the bears feeding they occasionally bring themselves into jeopardy by some senseless act. The black bears and the cubs of the bigger bears can readily be driven up trees, and some of the tourists occasionally do this. Most of the animals never think of resenting it; but now and then one is run across which has its feelings ruffled by the performance. In the summer of 1902 the result proved disastrous to a too inquisitive tourist. He was traveling with his wife, and at one of the hotels they went out toward the garbage pile to see the bears feeding. The only bear in sight was a large she, which, as it turned out, was in a bad temper because another party of tourists a few minutes before had been chasing her cubs up a tree. The man left his wife and walked toward the bear to see how close he could get. When he was some distance off she charged him, whereupon he bolted back towards his wife. The bear overtook him, knocked him down and bit him severely. But the man's wife, without hesitation, attacked the bear with that thoroughly feminine weapon, an umbrella, and frightened her off. The man spent several weeks in the park hospital before he recovered. Perhaps the following telegram sent by the manager of the Lake Hotel to Major Pitcher illustrates with sufficient clearness the mutual relations of the bears, the tourists, and the guardians of the

BLACK BEARS AT HOTEL GARBAGE HEAP.

public weal in the park. The original was sent me by Major Pitcher. It runs:

"LAKE, 7–27–'03.

"Major PITCHER, *Yellowstone:*

"As many as seventeen bears in an evening appear on my garbage dump. Tonight eight or ten. Campers and people not of my hotel throw things at them to make them run away. I can not, unless there personally, control this. Do you think you could detail a trooper to be there every evening from say six o'clock until dark, and make people remain behind danger line laid out by Warden Jones? Otherwise I fear some accident. The arrest of one or two of these campers might help. My own guests do pretty well as they are told.

JAMES BARTON KEY."

"9 a. m."

Major Pitcher issued the order as requested.

At times the bears get so bold that they take to making inroads on the kitchen. One completely terrorized a Chinese cook. It would drive him off and then feast upon whatever was left behind. When a big bear begins to act in this way or to show surliness it is sometimes necessary to shoot it. Other bears are tamed until they will feed out of the hand, and will come at once if called. Not only have some of the soldiers and scouts tamed bears in this fashion, but occasionally a chambermaid or waiter girl at one of the hotels has thus developed a bear as a pet.

CHAMBERMAID AND BEAR.

The accompanying photographs not only show bears very close up, with men standing by within a few yards of them, but they also show one bear being fed from the piazza by a cook, and another standing beside a particular friend, a chambermaid in one of the hotels. In these photographs it will be seen that some are grizzlies and some black bears.

This whole episode of bear life in the Yellowstone is so extraordinary that it will be well worth while for any man

COOK AND BEAR.

who has the right powers and enough time to make a complete study of the life and history of the Yellowstone bears. Indeed, nothing better could be done by some of our outdoor faunal naturalists than to spend at least a year in the Yellowstone, and to study the life habits of all the wild creatures therein. A man able to do this and to write down accurately and interestingly what he has seen would make a contribution of permanent value to our nature literature.

In May, after leaving the Yellowstone, I visited the Grand Cañon of the Colorado and spent three days camping in the Yosemite Park with John Muir. It is hard to make comparisons among different kinds of scenery, all of them very grand and very beautiful; yet personally to me the Grand Cañon of the Colorado, strange and desolate, terrible and awful in its sublimity, stands alone and unequaled. I very earnestly wish that Congress would make it a national park, and I am sure that such course would meet the approbation of the people of Arizona. As to the Yosemite Valley, if the people of California desire it, as many of them certainly do, it also should be taken by the national government to be kept as a national park, just as the surrounding country, including some of the groves of giant trees, is now kept.

John Muir and I, with two packers and three pack mules, spent a delightful three days in the Yosemite. The first night was clear, and we lay in the open on beds of soft fir boughs among the giant sequoias. It was like lying in a great and solemn cathedral, far vaster and more beautiful than any built by the hand of man. Just at nightfall I heard, among other birds, thrushes which, I think, were Rocky Mountain hermits—the appropriate choir for such a place of worship. Next day we went by trail through the woods, seeing some deer, which were not wild, as well as mountain quail and blue grouse. In the afternoon we struck snow, and had considerable difficulty in breaking our own trails. A snow storm came on toward evening, but we kept warm and comfortable in a grove

of the splendid silver firs—rightly named magnificent—near the brink of the wonderful Yosemite Valley. Next day we clambered down into it and at nightfall camped in its bottom, facing its giant cliffs over which the waterfalls thundered.

Surely our people do not understand even yet the rich heritage that is theirs. There can be nothing in the world more beautiful that the Yosemite, its groves of giant sequoias and redwoods, the Cañon of the Colorado, the Cañon of the Yellowstone, the three Tetons; and the representatives of the people should see to it that they are preserved for the people forever, with their majestic beauty all unmarred.

FOREST TREE SEED COLLECTING IN NEW MEXICO.

DESCRIPTION OF THE METHODS FOLLOWED IN GATHERING SEED FOR USE IN PLANTING ON THE NEBRASKA SAND HILL FOREST RESERVES.

BY

WILLIAM H. MAST,

BUREAU OF FORESTRY.

I ARRIVED at Glorieta, New Mexico, September 4, 1903. My object in going to the region was to investigate the seed crop, find suitable places for collecting, and to collect forest-tree seeds, principally western yellow pine.

A couple of days' riding was sufficient to show me that red cedar (*Juniperus virginiana*), one-seed juniper (*Juniperus monosperma*), and piñon pine (*Pinus edulis*) are confined to the lower parts of the mountains, while the western yellow pine (*Pinus ponderosa*), red fir (*Pseudotsuga taxifolia*), and white fir (*Abies concolor*) occur at higher elevations, and the limber pine (*Pinus flexilis*) and blue spruce (*Picea parryana*) at still higher elevations near the timber line.

The altitude of Glorieta is nearly 7,500 feet. Immediately to the south a large mesa rises about 500 feet above the town. This mesa is covered with piñon pine, interspersed with western yellow pine. The Pecos River valley at the foot of the mesa has a scattered growth of piñon and red cedar, nearly all of which is low and shrubby. Only a small per cent of these trees are more than fifteen feet high and many do not reach ten feet. The soil is a reddish adobe, containing small boulders; also deposits of sandstone and limestone.

At this time special attention was given to piñon pine, as its cones ripen earlier than those of most of the other species. Diligent searching revealed that the crop was very light in that locality. The trees, which were bearing, had an extremely poor quality of cones. They were small, with only two or three seeds developed, and often these were infertile. Some cones had been infested and destroyed by insects. The pine birds were beginning to take the better cones. The white fir, red fir, and western yellow pine cones were not ripe, so it was thought best to go to another locality. Accordingly I went to Santa Fé.

The low hills for several miles in every direction from Santa Fé are covered with red cedar and one-seed juniper, with some piñon pine, while the higher mountain slopes have red fir and western yellow pine, with a great deal of white fir in the canyons and stream beds. It was found that one-seeded juniper seed could be obtained without going far from Santa Fé, although only a small per cent of the trees were bear-

ing. Several days were spent collecting this species.

Upon returning to Glorieta some days later, the collecting of piñon pine seed was begun. This was followed by the collecting of red fir, white fir, limber pine, blue spruce, and western yellow pine. During this time more one-seed juniper was obtained near Santa Fé, and also small amounts of red cedar were gathered near Glorieta.

METHODS OF COLLECTING.

One-seed juniper (*Juniperus monosperma*).—Almost the entire amount of seed of this species collected was obtained within three miles of the city of Santa Fé. The trees were of low, brush-like form, from four to eight feet high. A piece of canvas was spread beneath the tree, and cards were used to remove the berries from the branches. The cards were of simple construction, each consisting of a soft wood board eight inches long by four inches wide, with one end shaped into a handle and a row of eight-penny nails driven through the board at the other end. The nails were arranged at distances too small to allow berries to pass between them, though space enough for twigs to pass through.

The berries were emptied from the canvas into sacks, and later worked over to separate the refuse material from them. For this purpose a sieve having quarter-inch mesh allowed most of the berries to go through, and those which still clung to twigs could be rubbed through. This sieve removed the twigs, and by running the berries over a sieve of ordinary window screen the leaves and dust passed through, leaving the berries clean. The same method was employed in collecting and cleaning red-cedar seed.

Piñon pine (*Pinus edulis*). It was difficult to get piñon pine cones, for the pine birds had visited nearly all the trees and taken the cones which contained good seed. The birds seemed to be able to discern accurately which ones contained good seed. Under some trees the ground was thickly strewn with cones from which the birds had removed the seed.

In collecting piñon cones the men climbed the trees, and either pulled the cones off or knocked them off with sticks and afterward gathered them into sacks. The cones were taken to a small log building, where they could be spread on shelves and dried. The shelves were three feet and five and one-half feet above the floor, and the heat was applied from a large fireplace in the corner of the room. Four or five days with the room at a temperature of 100 to 125 degrees were required to open the cones. Then only the large cones opened, the small inferior ones still remaining closed. I consider this method an unsatisfactory way of removing the seed, as there is danger of getting the temperature so high at times that the seed on the upper shelves may be slightly roasted, or at least its vitality may be impaired.

Red fir (*Pseudotsuga taxifolia*).—The red fir cones were plentiful. Trees from 25 to 50 feet high, with branches down within a few feet of the ground, were found more convenient to collect from than larger trees. The cones were thickest near the tips of the branches and in the tops of the trees. After climbing the tree a hooked stick was used to good advantage in getting hold of the tips of branches to draw them in where the cones could be pulled off with the hands. A stick about four feet long with an iron hook fastened to it was found quite useful.

With the proper curve in the lower hook it may be used advantageously by pushing it along the side of a branch to catch and break off cones from branches that are too rigid to be bent toward the center of the tree and brought within reach of the hands. Usually there are a great many cones about the leader at the top of the tree, where it is too small to bear the weight of the picker, and there is danger of breaking it if it is bent down far enough to be reached. The lower hook of the tool enables the picker to strip the leader upward without breaking it. It is best to start at the top of the tree and work down, for in this way the cones which come from the upper branches and lodge on their way down are shaken off when the lower branches are being picked; thus

no time is lost in dislodging cones that have been caught in falling.

A portion of the red fir cones were dried and opened by the same method as employed for the piñon pine. However, opening cones by artificial heat is not satisfactory. Where there is bright sunny weather and the cones have reached the proper stage of maturity before being gathered, they will open within a few days by sunning. If they can be placed on the south side of a building where they will receive some reflected heat they will open still more rapidly. I believe the change of temperature due to the cooling at night to be beneficial.

White fir (*Abies concolor*).—The white fir trees were found in the side canyons and sometimes in the bottom of the main canyons. The cones in nearly all cases, especially on the young trees, are found in thick clusters at the tops of the trees. As it was dangerous for the picker to climb so near the top of the tree, he was provided with a steel hook on a long handle to cut or break off the cones.

The cones were taken in sacks to the drying-room, where they were dried by artificial heat and the seed removed by passing the cones over a sieve. A sieve with a quarter-inch square mesh allowed the seed to go through, but kept back the cone-scales. By use of a sieve of ordinary window screen and by a small amount of winnowing, the dust and resin were taken out.

Limber pine (*Pinus flexilis*).—Only a small amount of limber pine seed was obtained. To secure cones it was necessary to climb the seed tree and break them off with the hands or knock them off with a stick. The seed of this species was also removed by artificial heat. However, only a small amount was required, as the cones were over-ripe when collected. In fact, some of the seed had already fallen from them before they reached the drying-room. Limber pine cones are usually ripe enough to be collected early in September, and the seed is very easily expelled when they commence to open. The trees of this species are not plentiful in the region of Glorieta, and those found were bearing only a partial crop this year.

Blue spruce (*Picea parryana*).—In this region the blue spruce does not appear below an altitude of 9,000 feet. Like the limber pine, it also ripens early.

As it was impossible for me to secure cones at the time of ripening, a man was sent into the woods in the latter part of October to get cones which had been cut down and burrowed by the squirrels. Several of the squirrels' storehouses were found, and 7½ bushels of cones taken from them. These cones had been cut down at the proper time and covered with moist leaves, so that they were still closed and in excellent condition. A few days' drying in the sun was sufficient to open them. The seed was jarred out by flailing, and then run through a fanning mill to clean it.

Western yellow pine (*Pinus ponderosa*).—The collecting of the western yellow pine seed was deferred till there could be no doubt about the cones being entirely ripe. A few cones were collected between October 1 and October 10, but collecting was properly commenced October 12, when half a dozen men began work. A few days later more than twenty-five laborers were collecting. Nearly all the cones were collected between October 12 and 26. Of the 1,120 bushels of cones collected, over 800 bushels came from trees growing on land held by private individuals; the remainder were gathered on the Pecos River Forest Reserve. The owners of land felled trees, picked the cones from them, and later cut the trees into ties and cord-wood. The men were paid 20 cents per bushel for cones delivered at the drying grounds.

The cones were fully ripe, and as there were far too many of them to attempt drying by artificial heat, they were spread on the bare rocks and on the ground to open. On account of the lack of space on the rocks in the vicinity to allow the cones to be spread out thinly, a large drying floor was prepared on an old threshing floor. This was a level dirt floor, about 40 by 50 feet, which had not been used for several years. The surface was cleaned of weeds and loose dirt, then well soaked with water, and a herd of goats driven back and forth over it till it was dry and hard.

Their sharp hoofs served well to mix the mud and pack it, so that when it was dry it presented a hard and comparatively smooth surface, less liable to break open with large cracks than if the mud had been firmed with a tamper, then allowed to dry in the direct sun.

Still the lack of space made it necessary to have the cones three or four layers deep over a large part of the drying grounds. The sun could have little effect on any except the surface layer. When this layer was open it was flailed to jar out the seed. When a small area was raked bare of cones and the seed taken up, closed cones were drawn over it, leaving another bare space for the removal of seed. In this way the whole pile was worked over, and when finished the seed had been swept up from all parts of the area and the closed cones brought to the surface ready for sunning. Four to seven days' exposure in the direct sun was necessary to open the cones sufficiently to get the seed out. Each pile was worked from three to five times. This amount of handling removed nearly all the seed. There was, however, a small quantity scattered around the edge of the drying grounds, which could not be recovered; also a small amount was taken by the pine birds, which came in flocks to the cone piles.

In sweeping up the seed from the ground and rocks, a great deal of dust, sand, and pitch was taken up with it. Access to a fanning mill made it possible to separate nearly all the foreign material from the seed. The wings were not taken off till after the seed had reached Halsey, Nebraska. To separate the wings from the seed, a small quantity of seed in a sack was beaten against a stone or block of wood till the wings were broken off, and then winnowed. By another method a quantity of seed in a sack was laid on the floor and rubbed with the foot till the wings were ground off, then winnowed. After putting the seed through either of these processes, it was perfectly clean. A loss of twelve per cent was sustained in the last cleaning of the seed.

Laborers hired for collecting seed were Mexicans. They were paid $1 or $1.25 per day without board. One man received $1.50 per day. This man was a first-class worker and was put in charge of other laborers a portion of the time, and also acted as my interpreter. Day labor was not used extensively in the collection of western yellow-pine cones, as it was found that a large number of pickers could be handled with much less trouble and more satisfaction when paid by the bushel upon the delivery of the cones. This plan saved a large expense for transportation which would have been incurred if the cones had been picked by day laborers, for some of them were hauled from points six to ten miles distant from the drying grounds.

Some men who could not have been induced to work by the day and who would have been worth very little if hired in this way were persuaded to commence collecting by the bushel. Some of these men brought in a great many cones, for by this arrangement all members of the family were allowed to work. Some men who had private holdings and usually made railroad ties for a living cut down trees on their own land and gathered the cones.

Mexican labor is not generally very efficient. However, it is cheap and is about all that can be had in that region. To secure satisfactory service it is necessary to be with the men and oversee the work.

The following table shows the amount of seed collected and the cost per pound of collecting each species:

Species.	Total pounds collected.	Cost per pound.
One-seed cedar	203	$ .235
Red cedar	13	.355
Blue spruce	9	.90
White fir	82	.355
Red fir	87	.73
Piñon pine	31	.71
Limber pine	4.7	1.47
Western yellow pine	1736	.23
	2165.7	

FOREST THINNING AND ITS RESULTS.

BY

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PART II.—THE RESULT OF THINNING.

THE Forest Academy at Tharandt has one of the oldest and most systematically carried out thinning experiments in Germany.* The stand is Scotch pine and belongs to the first-quality class. This tract was taken under observation in 1862, and since 1863 has received systematic thinnings in five-year periods. Three grades have been used—A, B, and C. The A grade only removes class V*b*, and may therefore hardly be called a thinning at all; but in B, classes V*b*, V*a*, and IV*b* are taken, and in C, besides these also class IV*a* and part of III. The table on the following page shows detailed results of this experiment.

The most noticeable fact in this table is the comparative lack of result in the B thinning. On the other hand, the C shows a most pronounced increase in quality and general character over the unthinned area. With two hundred trees less to the acre, the volume is the same as that in the first plot, the average tree being more than an inch greater in diameter and ten feet higher. This means that the timber is of a higher quality and will bring a much better price. There has also been an intermediate yield of 1,036 cubic feet of sound wood against 421 cubic feet of nearly worthless dead wood in the unthinned acre. It is also clear that the damage from wind, insects, etc., decreases with the degree of thinning, a direct answer to those who claim that thinning endangers the forest from windfall.

An experiment quite similar to that at Tharandt was instituted at the Austrian station in Mariabrunn.† The first thinnings were begun in 1882, and have been carried on in five-year periods to the present. The species is Austrian black pine (*Pinus laricio austriaca*), and the thinnings are designated I, II, and III, corresponding very closely to the above given A, B, and C. A light increment cutting is also included, designated by IV. This is out of the pale of thinning, but incidentally shows a poor result compared with III. The accompanying plate, taken from a photograph, shows the diameter growth of the average tree in each grade. The increased growth of III over I is very noticeable. On the other hand, II also shows very well.

As the result of a very greatly increased interest in this subject, which commenced about 1885, Prof. Buehler, then head of the Swiss Forest Experiment Station at Zurich,* began an elaborate experiment in thinning where four degrees were tested. These were designated by A, B, C, and D, corresponding to the table given in the preceding article. A total number of 254 experimental plots, averaging about an acre each, were laid out in spruce, silver fir, and beech, and all trials were rigorously carried out by the same system. Since that time other areas have been taken on, but, for the sake of brevity, only the outcome of a series of spruce thinnings in the Sihlwald will be discussed. The table on page 315 is a summary of the main results.

In this experiment the degrees of thinning differ slightly from those given in the preceding table. The A thinning approaches the B thinning at Tharandt, the Swiss B thinning lies between the German B and C, and the Swiss C slightly exceeds the C at Tharandt.

* Kunze in Tharandter Forstl. Jahrbuch, vol. 45, pp. 1–44; vol. 52, p. 157.

† Œster Forst. & Jagdt. Zeitung, May, 1903.

* Mitt. d. Schw. Centralanstalt f. d. Forstl. Versuchswesen, vol. 3, p. 7, and vol. vii, p. 1.

THINNINGS IN SCOTCH PINE (*Pinus silvestris*).

Year.	Age.		A.				B.				C.			
			No. per acre.	Average diameter.	Average height.	Volume.†	No. per acre.	Average diameter.	Average height.	Volume.†	No. per acre.	Average diameter.	Average height.	Volume.†
				Inches.	*Feet.*	*Cu. ft.*		*Inches.*	*Feet.*	*Cu. ft.*		*Inches.*	*Feet.*	*Cu. ft.*
1863	21	Total standing				172.9	3,894	2.2	18	172.9	3,267	2.3	21	172.9
1863–'69		Windfall, etc												
1869		Thinning *					330			14.4	760			29.6
1870	28	Total standing	3,125	2 5	23	1,064.8	1,863	3.0	27	1,031.1	1,501	3.3	29	1,134.0
1870–'74		Windfall, etc				87.2				47 7				43 0
1874		Thinning *	74			3.1	428			24.9	384			42.9
1875	33	Total standing	2,229	3.3	27	1,573.1	1,224	4.1	32	1,605.7	1,029	4.4	34	1,711.3
1875–'79		Windfall, etc				9.1				12.9				8.4
1879		Thinning *	87			16.6	50			20.3	38			24.0
1880	38	Total standing	1,594	4.0	30	1,940.7	1,110	4 6	35	2,154.1	974	4 8	34	2,441.2
1880–'83		Windfall, etc				17.9				21.6				54.5
1883		Thinning *	72			23.9	131			60 7	129			110 5
1884	43	Total standing	1,171	4 7	37	2,414 4	907	5.1	38	2,486.7	795	5 5	40	2,691 3
1884–'89		Windfall, etc				57.9				63.5				52.6
1889		Thinning *	57			37.7	91			89.8	145			237 4
1890	48	Total standing	921	5 6	44	3,397 8	753	5.9	44	3,148.9	620	6 5	50	3,504.9
1890–'94		Windfall, etc				55.2				40.3				24.9
1894		Thinning *	162			182.5	135			230.4	113			28 0
1895	53	Total standing	694	6.3	50	3,709 1	563	6 7	53	3,671.1	462	7 3	58	3,938.2
1895–'00		Windfall, etc	101			227.4	28			90.5	15			58.3
1900		Thinning *	64			157 6	104			303.4	115			563 7
1901	58	Total standing	529	7.2	52	3,749.8	433	7.6	56	3,584 6	331	8.4	62	3,744.7
		Total volume of thinnings *				421.4				743.9				1,036.1
		Total merchantable volume grown				3,749.8				4,328.5				4,780.8
		Windfalls, etc				454 7				276.5				241.7

* In "A" only dead wood removed.
† Wood 2½ inches and over in diameter at small end.

THINNINGS IN SPRUCE (*Picea excelsa*).

	A.			B.			C.			D.		
	1889.	1894.	1899.	1889.	1894.	1899.	1889.	1894.	1899.	1889.	1894.	1899.
Age	28	33	38	28	33	38	28	33	38	28	33	38
Number removed per acre	.....	51	132	232	121	144	486	44	176	852	20	141
Number after thinning per acre	1,447	1,275	1,143	1,205	1,065	921	934	881	704	677	638	497
Average diameter after thinning...in.	5.4	5.9	6.1	5.9	6.3	6.9	6.4	6.8	7.5	6.4	7.1	8.0
Average height " ...ft.	45.7	51.8	56.7	47.7	55.0	62.1	48.8	57.4	63.9	50.3	55.7	63.6
Volume removed per acre.....cu. ft.*	.....	78.6	421.6	337.3	271.5	417.3	934.7	126.1	866.1	2,116.6	90.0	831.8
Volume after thinning per acre..cu. ft.*	5,402.1	5,716.6	6,531.3	5,712.6	6,529.6	7,595.1	5,241.7	6,390.6	6,989.7	4,074.5	4,963.2	5,599.5
Total volume removed in three thinnings	.....	.....	500.2	.....	.....	1,026.1	.....	.....	1,930.8	.....	.....	3,038.4
Total volume grown	.....	.....	7,031.5	.....	.....	8,621.3	.....	.....	8,920.5	.....	.....	8,637.9

*To 4½ inches at small end.

At first glance the B thinning seems to give the greatest volume, but the number of trees is not much less than that in A, and therefore the quality and price is not radically bettered. On the other hand, C has 400 trees to the acre less than A, with a greater actual volume of 400 cubic feet standing, exclusive of 1,400 cubic feet more yield in the thinnings. It is also evident that the D thinning is too severe.

From a great mass of facts compiled in this report and covering about 150 experiments in all ages, certain important facts may be summarized.

The volume of merchantable wood left after thinning has never fallen below the volume left after the previous thinning.

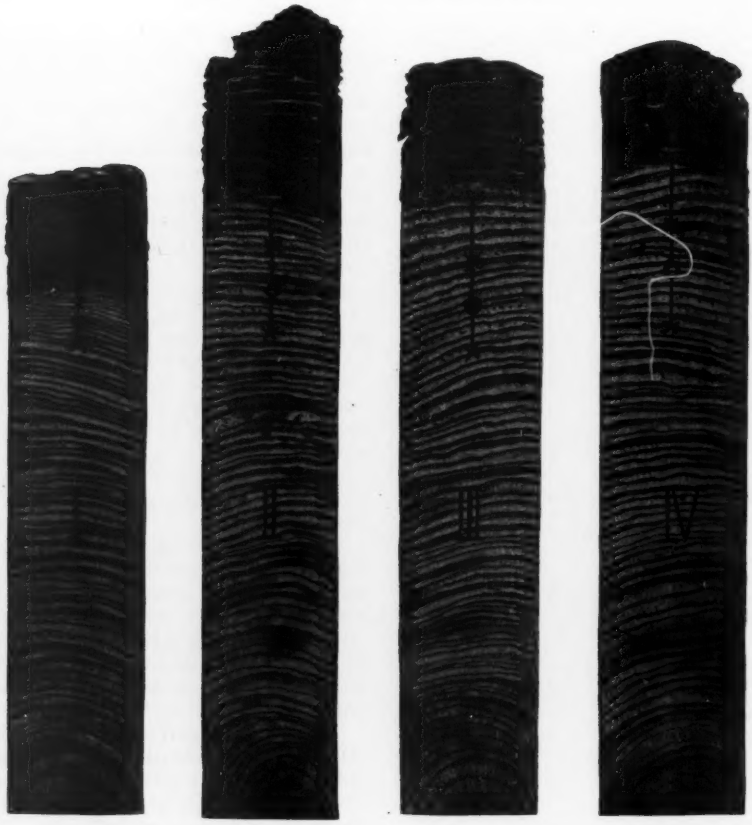
The cleanness of bole decreases with the degree of thinning. It is relatively best in B and C.

The greatest production of merchantable timber is obtained in the grades B and C. The best condition probably lies between B and C, with an inclination toward C. (This probably corresponds with the C thinning at Tharandt.) When expressed in money value, the C grade shows an even better result.

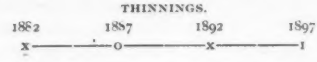
The current yearly height growth is better in C than any other grade of thinning. The lightly thinned area A shows the poorest height growth, and the increase in B is not remarkable. This point is clearly shown in every instance and is very interesting. It has been generally held that close-grown trees are very much stimulated in height growth, but these figures prove that a reasonable amount of room not only increases the diameter, but also the height. In this a most important argument has been adduced in favor of thinnings. When grown too openly, however, the relative height growth falls off, as shown in the D thinning.

The greater diameter growth in D takes place only in the lower part of the stem. The bole is more tapering and has less volume than in B or C. The best proportion between height and diameter is shown in C, with B closely following it.

In young and middle-aged spruce stands the thinning should lie between B and C, inclining more toward C.



THREE GRADES OF THINNING AND A LIGHT INCREMENT CUTTING (IV). SECTIONS FROM THE AVERAGE TREE IN EACH SAMPLE PLOT.



From the fiftieth or sixtieth year on the thinning should be about the C grade.

At the beginning of the last third of the rotation, or about the seventy-fifth year, the trees should be so formed and in such relation to each other that no more real thinnings are necessary. From this time on all the increment should be in the final stand.

Stands which are in bad condition through lack of early thinning or other causes should be successively thinned to the C grade, as they recuperate best by this method.

In these experimental results no mention has been made of selection thinning. The only figures which deal with this subject known to the writer are those of Dr. Wimmenauer in Giessen. In 1894–'95 he began the comparison with ordinary B and C thinnings with the Borggreve method and *éclaircie par le haut* or ordinary selection thinning. Borggreve's method takes out that part of the dominant stand which is merchantable in the expectation of developing dominant trees from the suppressed members of the forest.

After the first five-year period, in

1897–'98, the proportionate yield of each method stood as follows:

C thinning, 100 per cent.
Borggreve, 90 per cent.
Selection thinning, 82 per cent.

At the second thinning, in 1902–'03, the result had changed to:

C thinning, 100 per cent.
Borggreve, 65 per cent.
Selection thinning, 82 per cent.

Although this experiment has not progressed far enough for definite results, it seems already to show the impracticability of the Borggreve method. On the other hand, the position of selection thinning is better than the proportion would seem to evince. The stand was heavily cut into and has not had time to recuperate. The general appearance of the trees is better than by any method and the total increment is largely in the trees chosen for the final stand. The author expects that this method will finally give the best results of any system.

CONCLUSION—FOREST THINNING IN AMERICA.

The European results here summarized would have no interest or value in this country were it not for the useful experience which may be adapted to American conditions. German forestry is intensely conservative and has developed very slowly. This is especially true in regard to thinnings, as it may be safely asserted that four-fifths of the forest land today is not thinned beyond the A or B grade of the Tharandt experiment. Hartig, who practically founded the art of forestry at the end of the 18th century, laid it down as an axiom that no dominant trees should be cut and the cover never broken in thinning. In spite of modern teaching, his influence seems to still live, and the average thinning yields but a comparatively small amount of low-grade wood. Such a method may pay well enough in a country where wood is so dear as in Germany, but in America this timber could be removed only at a loss, and therefore could not be touched at all. Hence it is of the greatest importance that a method of heavy thinning shows the best financial results in both the final and intermediate yields. If a correct system gives large enough timber to make thinning pay, we can begin our experience with all the accumulated knowledge of Germany behind us and save ourselves time and trouble by commencing on the right track.

Of course, it is evident that it is only possible to practice thinning in a small part of the American forests. Throughout the great lumbering regions they are not to be considered at all, but there is a large area of country in the northeast where thinning should often pay if properly managed. In parts of New England, New York, Pennsylvania, Ohio, and Indiana there are numbers of woodlots and timber tracts which could be profitably improved by systematic thinning.

The tree classification is the most important and difficult preliminary to an effective system. The trees should be divided into enough classes to make several degrees of thinning quite distinct from each other, and at the same time the division should be so broad that there is no doubt of the class to which every tree in the stand belongs. The classification given in Part I is not difficult to apply after a little practice, but for American conditions the following plan seems more advisable:

Class I. Dominant. Trees which make the upper forest cover.

a. With symmetrically formed crowns.
b. With unevenly developed crowns.

Class II. Overtopped. Trees which have fallen in growth below the upper forest cover.

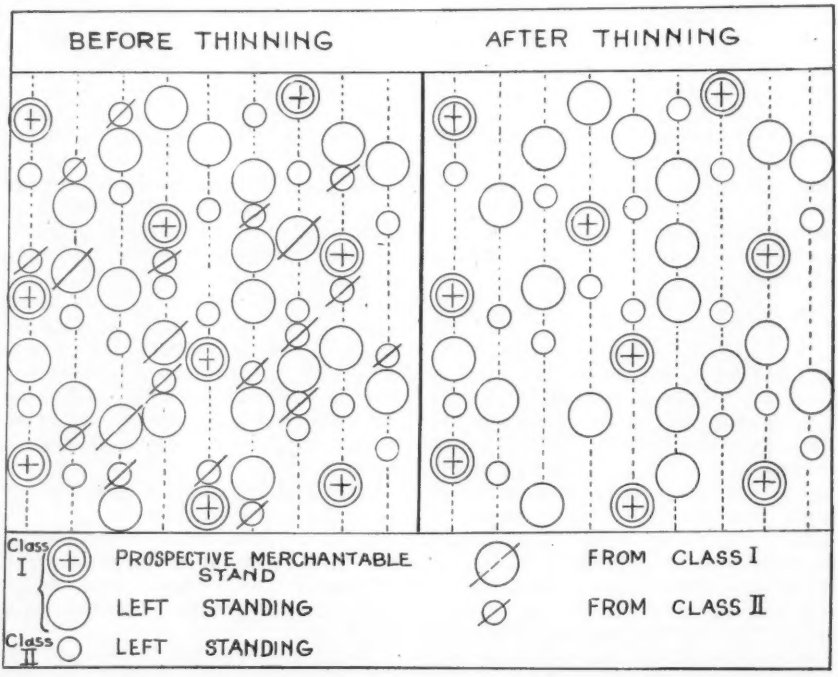
a. With crowns free to the light.
b. With crowns directly shaded, but still thrifty.
c. Dying or dead.

This grouping is less arbitrary than the other and follows nature more closely. Its simplicity will make it easy to apply to the conditions of the average woodlot. Trees belong to Classes I and II only in relation to their immediate neighbors. An individual which from its size belongs to Class II in one part of the forest may be in Class I where the general average is smaller.

As wood is cheap and labor dear, it follows that thinning will not pay until

the timber has reached some size. In the foregoing section it was shown that such woods do best when thinned to the C grade, which also yields a good amount of merchantable wood. The selection system, however, also shows well, and as a paying result is the first consideration for the average American thinning, it will be wise to combine the methods and cut the greatest amount of timber compatible with the best final yield.

there are probably many cases where woodlot owners are willing to make a reasonable outlay. In twenty-year-old growth or thereabouts, remove most of Class II and take out those specimens of Class I*b* and *a* which are noticeably crowding the better members of the same class. Cut all trees which have started a few years before the others and have grown up branchy or badly formed. If the mixture needs regulation, this is the time to attempt it.



THINNING IN 27-YEAR-OLD PLANTED WHITE PINE.

Every woodlot has different conditions, but there are a few general points which may be discussed in broad lines and which are applicable to all. True thinnings are only possible in stands of fairly thrifty growth which have a good cover. Ragged and sparse woods must be built up by improvement cuttings, which are not here considered.

A. *Thinning a Sapling Stand.*—There are not many places where it would pay to thin in young forests, but The cover should not be broken more than temporarily.

B. *Thinning in Pole Stands.*—If thrifty forest has got well into the pole stage without a thinning, there will be considerable wood for removal. Select particularly thrifty, well-formed trees from Class I*a* and set them free to a reasonable extent on all sides by removing any class which presses them. Bring the remaining members of I*a* and *b* into a good relative position by

judicious thinning, and remove all of II*c*, leaving II*a* and *b* for a ground cover. These latter are too small to take out profitably, and yet, by allowing them to remain for cover, more of the paying sizes in I*a* and *b* can be removed. The accompanying diagram represents a trifle more than four square rods of twenty-seven-year old white pine which has been thinned by this method. The selected trees are from 12 to 15 feet apart. It is expected that the final stand will be recruited from these, but if anything happens to some of them other members left from Class I will take their places. A similar but less radical method can be applied to a pole thinning which has been thinned in the sapling stage.

Thinning has little effect after the period of most vigorous growth. If the stand has become mature without thinning it will probably be best to make a light increment cutting or successive cuttings for reproduction.

LITTLE COLORADO RIVER.

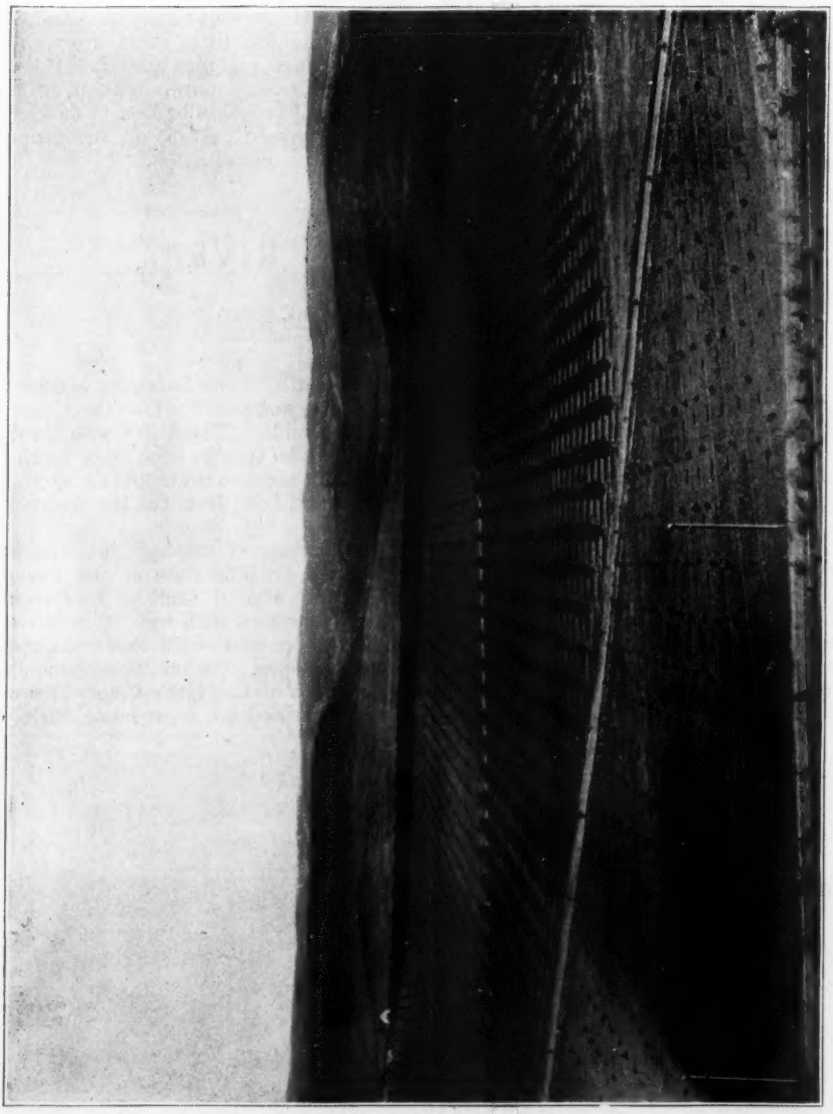
WITH ITS TRIBUTARIES MAY BE USED TO RECLAIM ARIZONA ARID LANDS.

A FIELD party consisting of members of the U. S. Geological Survey, under the direction of Assistant Engineer James G. Camp, has made an investigation of the possibilities of irrigation on the Little Colorado River, in Arizona.

The Little Colorado River drains nearly 9,000 square miles in northeastern Arizona and 6,000 square miles of territory in northwestern New Mexico, making a total drainage area of 15,000 square miles tributary to the river above Winslow, Arizona. This drainage basin extends from the Mogollon Mountains on the south to the Salahkai Mesa on the north, and eastward to the Continental Divide. There are two flood seasons—the spring flood, due to the melting of snow on the mountain slopes, and the fall flood from the late summer rains.

The surface of most of this area is either red or blue clay on the lower slopes and a solid sand or lava rock partially covered with sod. The latter covers 50 per cent of the mountain and foothill slopes. As no measurements of the flow of the Little Colorado nor its tributaries have been made during

WESTERN PLAIN COVERED WITH SAGE BRUSH, BEFORE IRRIGATION.



AFTER THE APPLICATION OF WATER.

the flood seasons, the amount of water available is entirely conjecture, but it is known to be very great at times and very small at others, being often entirely dry at places. From these conditions it is very evident that any reliable system of irrigation must depend on reservoirs, not only to hold the spring waters for midsummer use, but to carry the surplus of waters of a maximum year through a series of from three to five years to meet the conditions of drouth which sometimes prevail.

At present only a small area of land is irrigated along the Little Colorado River, there being small tracts of from 1,000 to 3,000 acres farmed by irrigation and scattered Mexican ranches consisting of only a few acres of garden and meadow. Approximately 16,000 acres are irrigated at present, but a large part of these lands lack water through July and August. This difficulty has been partly met by small reservoirs, but faulty construction and the resultant frequent breaking of dams make these reservoirs expensive and of but little real benefit.

In the valley of the Rio Puerco, the main tributary, are several fine bodies of land, but the fact that there are no reservoir sites above them renders them unavailable unless the underflow can be pumped onto them. Below the junction of the Rio Puerco and the Little Colorado is a valley from one to five miles wide, part of which is fertile, cultivable land, and below Winslow this valley widens out to eight miles in width and has a fine sand loam soil.

Zuni River and Cottonwood Wash drain considerable areas, mostly "bad lands," but their flow can not be depended upon, much of the time becoming lost in the soil, and at all times carrying so much silt as to make the storage of their waters impracticable.

The winters are not severe and the summers are hot and dry. Originally this section was a fine grass country, supporting large herds of cattle, but excessive pasturing of sheep and several dry seasons nearly ruined it as a grazing country. Alfalfa is the principal crop, but sorghum, corn, barley, and wheat give fair yields. Gardens and sugar beets do well, and fruit trees grow well, although the late frosts are injurious. Owing to the mild winters the main crops will always be forage.

Several dam sites were found, canal lines run, and estimates of cost made after thorough investigations of all the features. A general summary of the report shows that a storage capacity for 428,440 acre feet can be obtained; that there are 161,000 acres of agricultural land so situated that it could be irrigated from this system; that under irrigation this land will produce profitable crops, and that there is a market for these products. To determine accurately how many acres could be irrigated and the cost of this irrigation it will be necessary to establish gaging stations to obtain the needed data on the water supply and to make tests for silt and evaporation.

FOREST PLANTING IN WESTERN KANSAS.

BY

R. S. KELLOGG,

BUREAU OF FORESTRY.

FOREST planting along the eastern border of the Great Plains began years ago and has resulted in abundant success. Agriculture is pushing steadily westward, however, and where in 1873 the buffalo held almost unmolested sway, a single county raised nearly 4,000,000 bushels of wheat in 1903. The cattleman succeeded the buffalo, and he in turn will be dispossessed until much of the "short-grass country" is under the plow. Given a soil having the great

depth and fertility of that in western Kansas, together with an average annual precipitation of nearly 20 inches, even though it be somewhat periodic, it is safe to predict that American ingenuity and perseverance will eventually conquer. The sod-house days of '87 are past, and there is now a healthy, steady growth. The present settler comes here with a knowledge of conditions and the determination to master them. Improved methods of cultivation and drouth-resisting crops are being tried. The cattleman has found that he can raise sorghum and Kaffir corn practically every season, and that it pays better to feed his stock during the winter than to let them "rough it through" in the old-fashioned way. In the creek and river valleys alfalfa is being grown without irrigation clear to the Colorado line, and with the alfalfa go the dairy cow and the cream can.

It is unnecessary to enter upon any discussion of the causes of the well-nigh total lack of trees on the Plains. Whatever may be the reasons for the absence of natural forests, experience has proved that to a considerable degree artificial ones may be made to take their place. The generally accepted ratio is that for the best agricultural conditions one-fourth of the country should be forested. There is little likelihood that half this amount will ever be attained in western Kansas; yet the planting that will be done as the state increases in age and wealth will be sufficient to greatly modify the landscape and supply many domestic purposes. In favored localities commercial returns may be expected; elsewhere the recompense to the planter will be in the form of increased comfort and convenience.

The most extensive early plantings were on the timber claims. They generally resulted in failure because of wrongly chosen species and neglect. The man who made a timber-culture filing did so to get a quarter section of land, not because he cared for trees or knew anything about them. If he could evade the law and prove up without any trees whatever, he was quite likely to think himself that much ahead. There were some well-planted and conscientiously-cared-for claims; they speak for themselves today. The majority, however, came to little or nothing, and, after various modifications, the law was repealed in 1891.

The planter now plants because he wants trees and realizes their value; consequently he will be more careful in his choice and give more after attention than did his predecessors. A close examination of the country leaves little room for doubt concerning the success of forest planting in western Kansas if the species are intelligently selected and properly cared for. The attempt has been to make it conservative and practical rather than theoretical. It is written wholly from a non-irrigation standpoint, not because the writer does not believe in irrigation wherever possible, but because there is small prospect that large upland areas of the region will ever be irrigated. Since it is safe to say that the majority of the forest-tree planters will not irrigate, the species and methods suited to their needs are described. Those who are so fortunately situated as to have artificial water can get correspondingly better results with the same species, besides having others that can not be grown at all without irrigation.

WHERE TO PLANT.

In a naturally treeless region there is need for planting almost everywhere. Trees should be planted around houses, sheds, corrals, and garden patches for protection and ornament; planted in groves for posts, fuel, and the numberless uses which a stick of timber supplies; planted in parks and along streets, because trees are a great factor in making a town "a good place to live in;" planted in school-house, church, and court-house yards, so that public buildings shall not suffer by comparison with private ones, and planted for commercial purposes wherever possible, since a good plantation will afford a steady income, aside from much pleasure and convenience.

While general soil conditions vary little throughout western Kansas, there is abundant room for the selection of situations in which to plant. Trees, like other forms of vegetation, respond

quickly to good soil and moisture. The species which will grow on the uplands may be depended upon to do as well or better in the valleys, but the reverse case is far from being true. Hundreds of failures in upland planting in Kansas and Nebraska have resulted simply because the cottonwood, willow, soft maple, and box elder of the lowlands were expected to thrive in the drier situations. Some trees, the hackberry and elm, for instance, which grow naturally along water-courses, do well under cultivation on the upland, while others found in company with the hardy species fail entirely when the change is attempted.

The experimental stage has passed, and now the planter can use species whose worth has been proven, whatever his locality. There are local depressions on the upland which catch considerable run-off, and so are suited to species which need more than the normal precipitation of the region. In such a place on the high upland of Wallace county the writer was surprised one day to find a row of black walnuts, neglected in the sod, yet looking well and bearing nuts. It was the result of the haphazard planting of some settler who had long since departed and of whose sod house only a heap of dirt remained. The explanation was simple. A cattle trail and wheel tracks served to conduct the rainfall down the gentle grade to a shallow basin, and the instant the point was passed where water collected occasionally, only a few small stumps were left to tell the tale of drouth and disaster. Nearly every quarter section has some spot of an acre or more of this character which could be profitably utilized for tree planting. By putting the moisture-requiring species in the favored situations and the drouth-resisting ones elsewhere, the planter's range of choice is extended with most beneficial results.

HOW TO PLANT.

For plantations of the common broadleaf species, one-year-old seedlings are best to use, since they are easier handled and much cheaper than older trees. They ordinarily run from one to two feet high, and have no branches to speak of, so that little pruning is required. If the ground has been well prepared and is moist, the setting can be done very rapidly. A man and a boy work well together. The boy carries the trees and hands them to the man as wanted. The latter sets his spade full length in the ground, throws the handle forward, sticks a seedling in behind the blade, removes the spade, steps firmly with both feet on the ground around the tree, and the operation is complete, the whole thing not taking more than half a minute. A number of seedlings can be carried in a bucket partially filled with water or in a basket, with a wet cloth covering the roots, the remainder of the stock being left heeled in until needed. Another rapid method is to plow a furrow where the row of trees is wanted, lay them against the side of it, cover with a hoe, and tramp firmly. The remaining dirt can be thrown back with a cultivator.

Of course, it should be distinctly understood that these methods are only for the common broadleaf species when the right conditions exist, and will result in failure when applied to larger trees or evergreens. The important thing in all cases is to have the soil come into close contact with the roots; otherwise the air will get in and dry out both soil and roots. It is a good practice to set deep enough so that when the operation is finished the trees stand in a shallow depression. This will catch the rain and materially increase the chances of success in a dry season. An essential element in planting is suitable weather. Occasionally there are springs in western Kansas when it is altogether useless to set trees unless water can be supplied whenever needed. The planter who raises his own seedlings can take advantage of favorable conditions, have his trees perfectly fresh, and set when he pleases, or even let them wait until another year.

CULTIVATION.

Successful forest planting on the plains, where the rainfall is light and the evaporation great, depends largely upon the proper cultivation of the plantation. Nature has bountifully pro-

vided us with a deep, rich, easily worked soil, which the farmer is learning how to utilize best. The abundant crops which are sometimes produced with the poorest methods of cultivation have tempted many to use more land than could be well handled, but experience is proving that for a succession of years there is no question about the increase in financial returns to be secured by better systems of culture. The wheat-grower formerly thought that if he plowed his ground once in two or three years he was doing well enough. Now he has discovered that it pays to plow every year. Similarly the early tree planters often set their trees carelessly and left them to struggle unaided with dry weather and native vegetation. Now the planter knows that trees, too, respond most encouragingly to good cultivation.

The object of cultivation is twofold: First, to prevent the growth of weeds and grass; second, to conserve soil moisture. The natural supply of moisture in western Kansas is sufficient for the needs of several species of trees, provided it is fully utilized by the trees and not allowed to escape through evaporation or be diverted by weeds and grass. There is not enough to warrant any wasting. Before the trees are set the ground should be thoroughly worked and put into good condition. Virgin sod, unless very sandy, should be broken and farmed to other crops for two or three years prior to the planting of the trees. Deep plowing, followed immediately by the harrow, saves moisture and makes the soil easily penetrable by the roots. After setting, cultivation should be shallow and frequent. An ideal method is a surface cultivation as soon as possible after every rain. The nearer this ideal is approached the better the results will be. The dust mulch is the best mulch of all to save the moisture already in the ground and keep the soil in good condition to receive the next that comes.

The advantage to be gained by long continued cultivation of a forest plantation makes a rather wide spacing advisable, and with some species will necessitate some pruning of the lower limbs. The wide spaces between the rows, however, can be largely compensated for by setting closer in them. The common spacing of plantations under the provisions of the Timber Culture Act was 4 by 4 feet. Trees set this way could be cultivated for only a very short time. A 2 by 8 spacing gives the same number per acre and permits much more satisfactory cultivation. For species which need more room, a 3 by 8 or 4 by 8 spacing can be used at first, while with increasing age and size the space required for cultivation can be obtained by thinning. The less cultivation that is to be given to the plantation the thicker the trees should be set. Where the soil moisture is not conserved by cultivation, the stand must be thick enough to finally establish forest conditions of shade and litter, if the plantation is to succeed. It is undoubtedly true that on the plains wide spacing and frequent cultivation will produce better trees than close spacing and little or no cultivation.

Aside from the preparation of the ground for planting, the plow has no place among trees and should not be used thereafter. Too often it is the case that the plantation is neglected until the weeds have formed a dense mass 3 or 4 feet high, and then in desperation a plowing is given, not followed by a harrow of any kind. The plow leaves the ground rough, thereby greatly increasing the loss of soil moisture through evaporation. A dead furrow is formed between the rows, or the earth is thrown away from the base of the trees and many roots are cut, so that the root system is injured and the growth of sprouts encouraged. The man who is not willing to take proper care of his trees deserves to lose them, and quite likely he will.

The best tools for the preparation of the surface of the ground and subsequent cultivation are the Acme disc and dagger-tooth harrows and the five-tooth cultivator. The Acme harrow is an excellent tool for shallow cultivation, and, used frequently enough, it is all that is necessary most of the time. Another thing in favor of the Acme is the ease and rapidity with which it works. The western farmer, with his

hundreds of acres of land and thousands of bushels of grain, has learned the value of riding implements and rapid methods. He may ride an Acme harrow among his trees and still be sure that he is doing the best thing by them. The one-horse size is 3 feet 6 inches wide and the two-horse 6 feet 6 inches. Where the weeds have made a strong start, an ordinary cultivator may be put in or a shallow disking given; but the disk should be set quite slanting or followed by a harrow to produce the best surface conditions. Dagger-tooth harrows are made in five-foot sections, so a single section and one horse can be conveniently used between the rows of trees. The five-tooth, one-horse cultivator requires the least space of any of the tools mentioned, and can be used when the rows are quite close together or after the trees have filled most of the space.

An excellent example of the extent to which cultivation can replace irrigation is furnished by the Rainbelt Experiment Station at Cheyenne Wells, Colorado. The station was established in 1894 in a typical high plains region. The elevation is 4,200 feet, with water 260 feet below the surface. The annual precipitation is about 13 inches. An apple orchard set in 1895 contains fine, healthy trees, which have produced well. They are of the usual varieties common farther east, such as Ben Davis, Winesap, Janet, etc. The intention is to give two shallow cultivations monthly if possible. The tools used are a five-tooth cultivator and a dagger-tooth harrow with the teeth set slanting. While less has been attempted with forest trees at the station, there are some green ash a year older than the apples which are making good trees, and young honey locust are promising well. Since such good results have been obtained with apple trees, there is no doubt that the same method of cultivation would enable several species of forest trees to be successfully grown.

The Pomeroy model farm, at Hill City, Kansas, which has been practicing the "Campbell system" of cultivation since 1900, is a valuable experiment in methods applicable to the semi-arid regions. While the main object is the production of wheat and other farm crops, considerable has been done with trees. Besides fruit varieties, Russian mulberry, soft maple, and white elm have been set. They are doing well so far, although it is a very unfavorable situation for the maple and only fair for the elm. Cultivation is given as soon as the ground can be worked after every rain. An Acme harrow is generally used, preceded by a disk in case the weeds get too much of a start.

In river and creek valleys, where water is from 5 to 20 feet below the surface, cultivation is not ordinarily necessary after the trees get thoroughly established. The same is true in many places on the upland, where there are shallow basins which catch the run-off from a considerable adjoining area. In such situations the supply may be increased by plowing furrows along slopes lying above the plantation to collect water which would otherwise be lost.

Mulching has been practiced to some extent—hay, straw, or manure being used. It is better to mulch than to let the weeds grow. The mulch also checks evaporation and keeps the soil in good condition. The complaint is sometimes made that long-continued mulching brings the roots too close to the surface, and then they are exposed if it chances to be removed. The mulch certainly furnishes a congenial harbor for mice and all sorts of insects. The best mulch in all respects is the dust mulch, secured by cultivation, while the most suitable place for the one of hay or straw is around trees set in the sod, where it is inconvenient or undesirable to cultivate. Along a hedgerow, for example, a mulch may be of much benefit.

Occasionally field crops are planted between the rows of young trees, but the person who has any regard for their welfare will not do so. The trees need all the moisture and should not be forced to divide with other vegetation. Corn is especially harmful. The roots will spread both down and out for 4 or 5 feet and take much more soil moisture than do the young trees. If any crop is to be planted, it should be a short-lived one of the garden kind, either

small truck or potatoes. Their roots do not spread far and are soon gone, while the return from them will be sufficient to pay for the cultivation which should be given to the trees were they planted alone.

A sure way to ruin a young plantation is to turn cattle into it. Even if the trees are too large to be broken off by rubbing, every branch within reach will go, and forest conditions of shade and undergrowth be destroyed, so that weeds and grass can easily get a foothold. The damage to large trees in situations where moisture is abundant is not so great, and the protection furnished to stock in such a case may be of more value than anything else. The principal injury to older trees is by trampling. A heavy soil becomes packed so that it is nearly impervious to water, while a sandy one is worn away, leaving the roots exposed.

WHAT TO PLANT.

In order to succeed in forest planting in western Kansas, a careful selection of species is as important as good care. Many kinds of trees can not be made to thrive, no matter how much cultivation be given, and the planter must in some cases be content with what he can get rather than what he wants. Experience has thus far demonstrated that 15 or 20 species of forest trees can be grown, and no doubt the number will be increased by future experiments. The many past failures have taught valuable lessons, which are being heeded. Omitting the less desirable species, those adapted to various situations and purposes may be classified as follows:

UPLAND SPECIES.

For upland planting under ordinary conditions, the honey locust, Osage orange, Russian mulberry, and red cedar are of superior hardiness and may be relied upon for good results. Next in hardiness come the white elm, green ash, hackberry, and Scotch and Austrian pines, all of which do very nicely when properly cared for.

VALLEY SPECIES.

For valley situations, where the roots will eventually get the benefit of permanent water, all the upland species are excellent, and to them may be added in many localities the cottonwood, boxelder, soft maple, black walnut, and hardy catalpa.

COMMERCIAL SPECIES.

In favorable situations, where growth is rapid, these species may be profitably planted for commercial returns: Osage orange, black locust, Russian mulberry, and hardy catalpa.

MICHIGAN STATE AGRICULTURAL COLLEGE.

DESCRIPTION OF ITS COURSES IN FORESTRY AND THE EQUIPMENT FOR THIS DEPARTMENT OF ITS WORK.

THE course in forestry at the Michigan Agricultural College, an institution established in 1857, and the oldest in this country, was put into operation in September, 1902. It is a four-year course, designed to instruct students in agricultural subjects as far as they will be likely to have demand for it, and to afford an opportunity for students to prepare themselves for the profession of forestry. With the former object in view, the freshman and sophomore years of the course are identical with the same terms in the agricultural course. The instruction in forestry proper occupies the junior and senior years, although the curriculum for the sophomore terms in all courses includes preliminary forest work. In the junior year there are 552 and 588 hours of class-room and field or laboratory work, respectively, of which 192 and 216 hours

are forestry. In the senior year there are 84 hours of class-room work in forestry, with an additional 624 hours in other lines, and 540 hours of field or laboratory work, of which 216 are in technical forestry.

In the junior year students study principles of forestry, forest botany, wood technology, silviculture, plant propagation, forcing of vegetables and flowers, economic fungi, sanitary science, logic and argumentation, English literature, voice culture and declamation, German, and military science. In the senior year the work includes the study of forest

ON THE CAMPUS, MICHIGAN AGRICULTURAL COLLEGE.

mensuration, protection, regulation, valuation, investigation, economics of forestry, diseases of trees, higher civil engineering, advanced German, advanced zoölogy, geology, meteorology, and military science. The aim is to give as broad training as possible consistent with the necessary technical work. Instruction is given by practical demonstration in the nursery; in the 200 acres of land on the college farm, set aside for this purpose; on virgin timber near by; through lectures, textbooks, and other literature. The opportunities for practical work in forestry at the college are particularly good. Many

of the native trees that were growing at the time of the founding of the college, in 1857, are still in a thrifty condition, and the campus now contains over 600 native and introduced species and varieties. The woods on the college farm comprise nearly 200 acres, used primarily for demonstration in this department, and, in addition, 3,000 acres of virgin forest in Oscoda county have been set apart for its use. For practical exemplification of modern lumbering methods, etc., it is proposed to spend two weeks during the latter part of the spring term of the senior year in the forests and logging camps of northern Michigan.

As stated, forestry students during the freshman and sophomore years do the same work as those taking the agricultural course.

The schedule of subjects pursued in the two latter years of the forestry course is as follows:

Junior Year—*Fall term.*—Principles of forestry, including three hours per week class-room work, and four hours laboratory or field work per week; forest botany, two hours per week class-room work; horticulture (pomology), five hours per week class-room work;

CORNER OF NURSERY, MICHIGAN AGRICULTURAL COLLEGE.

botany (economic fungi), nine hours per week laboratory work; English (logic and argumentation), three hours per week; political science (political economy), five hours per week; military science (drill), three hours per week first half of term.

Winter term.—Principles of forestry, three hours per week class-room work; forest botany, two hours per week class-room work and four hours laboratory work per week; wood technology, eight hours per week laboratory; horticulture (forcing vegetables and flowers), ten hours per week laboratory; English (English literature), three hours per week; English (voice culture and declamation), one hour per week; German (elementary), five hours per week; military science (drill), three hours per week second half of term.

Spring term.—Forestry (silviculture), three hours class-room and four hours field or laboratory work per week; forest botany, two hours of class-room and four hours of field or laboratory work per week; botany (physiological), six hours per week laboratory; English (voice culture and declamation), one hour per week; bacteriology and hygiene (sanitary science), two hours per week; German (elementary), five hours per week; military science (drill), three hours per week.

Senior Year—*Fall term.*—Forest mensuration, eight hours per week laboratory or field work; history of forestry, two hours per week class-room work; civil engineering (higher surveying),

VIEW IN THE PINETUM, MICHIGAN AGRICULTURAL COLLEGE.

five hours per week class-room work and field practice; German (elementary), five hours per week; zoölogy (systematic and economic), five hours per week; military science (drill), three hours per week.

Winter term.—Forest protection and regulation, two hours per week class-room work, first half of term; forestry (diseases of trees), two hours per week class-room work, second half of term; forest investigation, six hours per week laboratory or field work; German (advanced), five hours per week; civil engineering (agricultural engineering), five hours per week; geology (structural and historical), five hours per week; military science (drill), three hours per week, last half of term.

Spring term.—Forest investigation, four hours per week laboratory or field work; forest valuation, three hours per week class-room work; German (advanced), five hours per week; geology, five hours per week; meteorology, five hours per week; military science (drill), three hours per week.

The course in forestry at the Michigan Agricultural College enjoys the advantage of having several subjects—those that bear on the subject of plant propagation, plant classification, and soils—taught in the departments of agriculture, horticulture, and botany. During their course, students sit under the instruction of nearly thirty professors and assistants. With the facilities and opportunities offered at this college, it is expected that the man who completes the course will be well prepared to begin his professional work as a forester.

Judging by what it has already done, this new department in the Michigan Agricultural College, an institution that claims the distinction of being the oldest of its class in the country, bids fair to uphold the enviable reputation already sustained by it in all its other departments.

IRRIGATION PROJECTS FOR WYOMING.

RECLAMATION SERVICE PLANNING TO RECLAIM 150,000 ACRES OF ARID LAND.

IN a report recently transmitted to the Chief Engineer of the Reclamation Service by Jeremiah Ahern, district engineer, it is stated that it is proposed during the next few months to complete the construction of a wagon road and a telephone line, in connection with the Shoshone Project; to make borings at the dam site; to make designs of various structures; to continue the location surveys of canal and tunnel lines, and topographic surveys of the irrigable land.

The wagon road is being constructed into the canyon over which to transport material to the tunnels and dam site. The main canal and tunnels are being staked out on the ground, and a topographic survey of additional lands is under way, and designs and a study thereof are being made for an impounding dam of increased height.

The Shoshone Project contemplates the utilization of a portion of the surplus water of Shoshone River for the reclamation of land in the northern part of Big Horn county, Wyoming. Shoshone River receives its water from the high mountains adjacent to and east of the Yellowstone National Park. The North Fork rises near the eastern boundary of the park, a few of its tributaries having their sources within its limits. For the first few miles of its course it flows southerly, then easterly for about 45 miles to its junction with the South Fork, which comes from the southwest and is of about the same length as the North Fork, but discharges a smaller quantity of water. Just below the junction of the two forks, Shoshone River enters a canyon 3½ miles in length. Beginning at the upper end of this canyon and for a distance of 1½

THE BIG HORN RIVER, WYOMING.

miles the canyon is through solid granite. The narrowest place in this part of the canyon is 65 feet wide at the bottom, and at an elevation of 250 feet above the bottom it is 200 feet wide. After leaving the canyon the river flows northeasterly through a generally rolling country to its junction with Big Horn River, near the northern boundary of Wyoming. From the mouth of the canyon to a point some 60 miles down the river, areas of bench land lie on both sides of the river.

The drainage basin of Shoshone River above the canyon contains approximately 1,250 square miles, nearly all of it being within the Yellowstone Forest Reserve. A comparatively small portion of this water has been utilized.

Surveys made by private parties previous to the field work of the Reclamation Service in 1903 indicated the feasibility of several alternate projects, and in order to test the relative merits of all alternate projects it was decided to make a topographic survey of all the irrigable land, and of all feasible conduit lines in the canyon. Preliminary estimates show that the construction of a high line canal is feasible, the cost of the entire work proposed being less than $2,250,000. These preliminary plans were passed upon by a board of engineers, and on February 10, 1904, the Secretary of the Interior set aside $2,250,000 of the reclamation fund for the construction of the project, "provided that satisfactory rights to land and water be secured, and provided that further consideration of details on the ground by consulting engineers results in favorable reports."

The canal lines as located cover 103,000 acres of land, of which 93,000 are irrigable. By extending the main canal through the "Bad lands" below Garland, it is estimated that 40,000 to 50,000 acres additional, in the vicinity of Frannie, Wyoming, may be reclaimed. The total area reclaimed will probably exceed 150,000 acres. This land is at an elevation varying from 4,000 to 5,000 feet above sea level. Power for pumping water to land above the canal may be generated at several places. All of the land under this project has been segregated.

Preliminary surveys and reconnaissance work have also been carried on to considerable extent to determine the feasibility of storing water in Lake De Smet and at the headwaters of Grey Bull River.

FOREST RESOURCES OF TEXAS.

THE SPECIES OF TREES, THE KINDS OF FORESTS, WHERE LOCATED, UPON WHAT DEPENDENT FOR DISTRIBUTION, AND HOW THEY SHOULD BE MANAGED.

OF all the states in the Union, Texas has the largest wooded area; nor does this include the chaparral growth extending throughout the Rio Grande country, but only the vast timber section of east Texas and the central and far western woodlands. These are estimated at 64,000 square miles. Much of this territory has been cut over, especially in the shortleaf and longleaf pine sections; but conservative estimates still place the merchantable forest area of Texas at 27,000 square miles. There is now annually cut about 125,000 acres of timber land, yielding about a billion board feet. The lumber industry is exceeded in value only by the cotton and cattle industries. In its forests Texas has 61 species and varieties of trees of commercial importance.

The most valuable forests commercially are those in the eastern part of the state. This is because that is the region of abundant moisture. These include the swamp and bayou forests near the Louisiana boundary; on the more elevated lands a little farther west a range of hardwoods, and then the three great pine types of the state. Next to these on the west are the post-oak lands, extensive but of low commercial value, while to the south and southeast is a coast-plain belt of heavy live oak, which is rapidly spreading over the prairie. Directly west again come the "cross-timbers," with the post oak of the Carboniferous area, while to the southwest are the 15,000 square miles of Edwards Plateau timber; then, after a big jump across country, in the extreme western and high section of the state, are found the piñon pine, red fir, and other Rocky Mountain species. These are the great east and west timber subdivisions; but running down the river courses to the Gulf are the alluvial bottom hardwoods, and then from the extreme southern point of the state and from the Gulf coast in Brazoria county, with a broad sweep to the north and northwest up to the top of the Pan Handle, is the pervasive chaparral growth. This last is persistently in the area of small rainfall, a product of the arid regions.

In the swamp and bayou forests there is at present little lumbering. There has been extensive cutting from the hardwood forests for railroad construction supplies, but the vast body of this timber in east Texas remains untouched, and offers a splendid field for the hardwood manufacturer. Of the total annual output of the state the longleaf pine forests now furnish about 750,000,000 board feet. Half of these forests have been cut over, and it is estimated that if a billion board feet are cut annually their timber supply will be exhausted in fifteen years. Under present conditions renewal is impossible, because of the manner in which lumbering is conducted and the prevalence of forest fires. There must be education of the people as to the terribly destructive effects of fires, penalties enacted to limit their occurrence, and conservative lumbering methods inaugurated at once, if Texas is to retain any longleaf pine forests of commercial value. Already its shortleaf pine forests are pretty thoroughly exhausted. The loblolly pine is very abundant and commercially valuable, and is found in close mixture with hardwoods in east Texas. The forests of the post oak and live oak lands and the Edwards Plateau furnish trees which are of little commercial importance, but they are most valuable for fuel and small construction timber. Especially is this true of the cedar brakes, which extend 200 miles northwestward from Austin and furnish not only the best of fuel, but posts, crossties, and sills. The chaparral growth is of no value commercially.

Texas has a serious task ahead in the management of its forests. The interests of the state as a whole demand protect-

ive forests. Texas has sold nearly all of its forest lands, and could not establish forest reserves without repurchasing on a large scale. It is doubtful whether the people of the state would, at this time, favor such a policy. So that any general system of conservative forest management must be put into effect by private individuals, who now own 95 per cent of the commercial woodlands. In this management large benefits, both public and private, will come from the proper control of the woodlot and larger tracts. In this work every farmer in Texas can be an assistant. By protecting and properly utilizing his own little tract of woodland he can not only raise his own fuel and farm repair material, but can also contribute his mite toward helping to reforest the state, and thereby increase the reserve water supply. To this end the practice of forestry becomes a very important matter all over that state. The two great causes of complaint there are heat and drouth. Both can be mitigated by preserving and extending, where proper, the forests of the state.

There is one phase of the question, however, that goes beyond the power of the private owner. It is when, for instance, the relations of the lowland farmer to the upland cattle grazer are considered. The latter can not be expected to regulate his affairs for the benefit of the former to his own real or supposed detriment. The cattleman on his river watershed grazes his cattle and burns the prairie without any regard to what effect it will have on the flow of the river, upon which the lowland farmer is so dependent. And it is here that state action and protection should come in. The rough hillsides, canyons, and eroded slopes of the headwaters and middle courses of the rivers should be kept under good forest cover. Properly safeguarded with this permanent forest cover, the flow of Texas rivers would be far better regulated than now. Danger from floods, that almost annually destroy great crop areas and much valuable property, would be materially lessened. What is still more important, these protective forests would cause a storage of water, to be given out in regular supply to streams and thus made most available for use in the dependent agricultural sections.

For the last two years the Bureau of Forestry has been engaged in a careful study of forest conditions in Texas. Its collaborator in that work, Prof. William L. Bray, has now prepared a bulletin entitled "Forest Resources of Texas." This bulletin, which describes and classifies the forests of the state, deals with the determining causes of their distribution, and discusses fully both private and state management, will be issued soon.

SOUTH DAKOTA RECLAMATION WORK.

TERRITORY IN VICINITY OF BLACK HILLS MAY BE RECLAIMED SOON.

THE Reclamation Service has received a report from Mr. Raymond F. Walter, engineer for South Dakota, which contains some interesting information in regard to the work being carried on in that state.

Attention has been given only to reclamation possibilities west of the Missouri River, and more especially to those in the vicinity of the Black Hills, and it is found that any reclamation attempted on any of the streams of this section must be founded on storage of storm water and spring and winter flow. With this in view, the country around the Black Hills has been carefully investigated for storage possibilities and the north side has been selected as the most promising. This project is known as the Belle Fourche Project, the water supply being taken from the Belle Fourche River and its tributaries.

The Belle Fourche River rises in the east central portion of Wyoming and

flows northeast, then east, draining the western and northern portions of the Black Hills. This project involves the reclamation of the lands to the northeast of the Black Hills, in Butte and Meade counties, South Dakota, by the diversion of the waters of the Belle Fourche and Red Water rivers into basins east of the town of Belle Fourche. These basins are to be converted into storage reservoirs by the construction of embankments of earth, riprapped with rock, across the outlets.

The reservoirs will be filled by a large feeder canal from the river, 6 miles long, 40 feet wide on the bottom, and carrying 10 feet of water. This supply will be augmented by water from Crow, Owl, Indian, Horse, and Willow creeks, which have large flood flow during certain periods. From these reservoirs the water will be distributed to lands in the valley on both sides of the Belle Fourche River, where between 60,000 and 100,000 acres of land may be reclaimed, depending on the water supply obtainable, the records not being sufficiently near completion to fix the amount at the present time.

In April a field force made a reconnaissance survey to determine the possibility of an increased water supply from the Little Missouri River and the storage of water so obtained. During May, 1904, the Secretary of the Interior gave his preliminary approval to the project, and conditionally set aside $2,100,000 for its construction, if final report is approved by him. The organization of the land-owners under the project has been begun, and will be similar to that of the Salt River Valley Water Users' Association.

The diversion canal from the Little Missouri River to the Belle Fourche River will be located during the present season, and a reconnaissance made of the headwaters of the Little Missouri and Belle Fourche rivers for any possible storage to impound the excess flood waters and act as an equalizing basin. If a possible site is located surveys will be made.

In addition to the Belle Fourche Project, there are a number of other projects in the Black Hills district that are receiving some attention with a view to future reclamation. The most important of these are on Rapid Creek and Little Missouri River, where some preliminary surveys have been made and the water supply is being investigated. This work is being done principally in connection with the work of gaging streams in South Dakota.

Other reconnaissances and surveys will be taken up as opportunity offers. Numerous gaging stations have been established and maintained on the various streams, and miscellaneous measurements are made whenever opportunity permits on the smaller streams in the district.

STUDY OF THE RED GUM.

RAPID GROWTH, OCCUPATION OF SWAMPY LANDS, AND IMMUNITY FROM FIRES ATTRACT ATTENTION TO THIS TREE AS A MEANS OF CONTINUING THE LUMBER SUPPLY.

RECENT investigations of the Bureau of Forestry indicate an important addition to the present timber resources of the country through the better utilization of the red gum. This timber tree is the predominant species on the hardwood bottomlands of all the Southeastern States. In spite of its abundant supply, it has been slow to reach commercial importance because of the extent to which it warps and stains in seasoning. While hickory, oak, ash, and yellow poplar were cheaply obtainable, red gum received little attention. The increasing scarcity and rising price of more adaptable trees have forced the gum into a market place of late, and have caused lumbermen to seek, with partial success, such methods of handling it as would obviate the difficulties which have stood in the way of a larger use of the wood.

In common with all the hardwood bottomland species—ash, cottonwood, and oak—its growth is very rapid. It reaches a maximum height of 140 feet and is commonly 30 to 40 inches in diameter, while trees of five feet in diameter are not infrequently found. Little red gum has been cut in the past, and at present it hardly pays to cut below 18 to 20 inches in diameter; so that this species furnishes a magnificent supply of full-grown timber in regions where culling has removed most of the larger trees of other kinds. The wood is comparatively straight-grained, free from knots and blemishes, and, because of its abundance, cheap. It is now used extensively for building timbers, flooring, boxes and barrels, and for numerous purposes where narrow boards can be used. It has been found that wide boards are very liable to warp.

Sixty per cent of the barrels and boxes manufactured in the Mississippi Valley states are now made from this wood in spite of the fact that its heaviness is against it for this use. Large quantities of gum are shipped to England, France, and Germany to be manufactured into furniture and interior furnishings, and it has been used extensively in Europe for paving blocks. It can be successfully steamed and bent and is thus available for barrel staves, wagon rims, and carriage wood stock. If the tendency of the lumber to warp and stain during seasoning can be prevented, its use will extend into many new fields. Certain facts have lately been discovered which show that such an extension is possible if proper methods of handling are employed. The heartwood can be air-dried without great stain or warp. Sapwood, however, if air-dried directly after coming from the saw, usually develops a large percentage of sap stain, which is caused in the case of most all conifers and hardwoods by a fungous growth which develops under certain conditions of humidity and temperature in the lumber yard, but it has been found that lumber from logs which have been allowed to remain in water for six weeks stains very little. Treatment with live steam has also been found to produce very favorable results in the elimination of staining and prevention of warping.

In steam kilning the timber is thoroughly soaked in live steam for 48 to 72 hours, and is then dried by steam radiation for from 72 to 144 hours, according to the condition of the timber. The boards should then be air-dried for from two to three months. Lumber above one inch in thickness is air-dried only. Care must be taken in piling for air drying to secure free circulation of air. Plenty of open space should be left between the boards, and the piles should not be over six feet wide. "Stickers" or cross-pieces of non-absorbent wood should be placed not over three feet apart. For this purpose oak and the heartwood of gum answer excellently. Stickers of sappy or undried wood are very likely to cause stain to develop. By following these methods the lumbermen are able to furnish a better grade of timber, which has in consequence secured a firmly established place on the market.

The Bureau of Forestry is now making, at its timber-testing laboratory at Lafayette, Ind., extensive tests to determine more fully the value of gum timber in comparison with higher-priced materials. Mechanical tests are made on timber collected from various parts of the country, including samples taken from both mature and immature timber at different parts of the trunk. The young trees contain a greater proportion of sapwood than the mature trees, and show about 35 per cent greater strength. The strength of the wood is very uniform in the trunk between the stump and the first limb. The results of the tests point to the fact that red gum timber has a high degree of strength as compared with other species, not only in small selected sticks, but also in large joists. Its freedom from knots in large sizes is an advantage in this respect. A joist of red gum will carry as great a load as a joist of North Carolina pine.

Comparisons have been made by the Bureau between red gum and hickory to determine the ability of the former to serve as material for carriage and wagon wood stock. No trouble was found in making satisfactory bent pieces for buggy

shafts and wagon rims, and the red gum promises to take the place of cheaper grades of hickory, oak, and ash for these purposes. The principal objection is that at the present time no satisfactory process of drying has been devised to overcome the warping and twisting of red gum in the larger sizes, but plans are now being made for a series of experiments to determine the proper operation of a kiln to this end.

An important question for timber owners in the region where red gum abounds is, whether management for future production will be a wise business policy. This question the Bureau of Forestry has been investigating during the past winter with interesting results.

Red gum forests are now beginning to be lumbered on a very extensive scale. The lands which they occupy are usually more or less swampy alluvial bottoms. While often very fertile they are apt to be subject to floods, and the cost of drainage is often high. Whether they will pay better if kept in timber or whether they should be sold for farming is a somewhat difficult question. One great advantage for forest management which they have over pine lands, for example, is their comparative immunity from fire. The owner of a good forest of red gum is not in danger of seeing his whole investment go up in smoke. The red gum is a swamp species, and its rapid growth points to the conclusion, at least in certain sections, that the land can be profitably held for a second crop.

The field studies carried on by the Bureau of Forestry during the last winter were made on the lands of the Himmelberger-Harrison Lumber Company in Missouri, and on the tract of the Santee River Lumber Company in South Carolina. Figures on rate of growth in height, diameter, and volume were obtained, which will be later embodied in tables showing the rate of growth, age, and contents in board feet of trees of various diameters. A careful study of second growth and stand per acre was also made, and on these data it is hoped recommendations can be made for the management of these hardwood bottom lands so as to obtain a continual supply of timber.

Other studies have secured the data for a discussion of the reproduction and other characteristics of the red gum and of lumbering methods employed throughout its range. In addition, an inquiry has been made into the subject of market conditions and the uses and manufacture of the wood. All these phases of the investigation will be fully discussed in a bulletin, in course of preparation, on the red gum as a commercial timber tree.

RECENT PUBLICATIONS.

Homophonic Conversation Book. In English, German, French, and Italian. Being a natural aid to the memory in learning these languages. By C. B. and C. V. WAITE. Price, $1.00. C. V. Waite & Co., 479 Jackson Boulevard, Chicago.

This little book is, as its title indicates, based upon the similarity in sound and in signification of the principal words used in the sentences. That this will aid the memory is undeniable.

The conversations are arranged under different headings: Salutation, The Time, The Weather, The News, etc.; also covering the various situations and emergencies in travel: Before Sailing, On Board a Steamship, Landing, At an Inn, Taking Furnished Rooms, Traveling by Railway, Breakfast, Dinner, Tea, and Supper, Interviews with a Tailor, Shoemaker, Physician, Bookseller, etc.—in all, thirty-one headings; also cardinal and ordinal numbers and divisions of time are given, whether homophonic or not.

Nearly 500 homophonic words are used, an alphabetical table of which is added, giving the form of the word in each language.

This is a duodecimo volume of about 140 pages, printed on the best paper, and handsomely bound in flexible cloth, being a neat pocket companion for travelers.

The Trail of Lewis and Clarke, 1804–1904. By OLIN D. WHEELER. 2 vols. G. P. Putnam's Sons, New York.

No study of the Northwest is complete, nor can one understand as one should the imperial dimensions of that vast domain or its real present and future greatness without some

knowledge of the wonderful explorations of Lewis and Clarke in 1804–1806.

That historic expedition, consisting of 45 men (later, at Fort Mandan, reduced to 31 men and one Indian woman, with her three months' old papoose), left St. Louis, ascended the Missouri River to its headwaters, crossed the mountains to the Columbia, and descended that stream to its mouth, and returned within less than two years and a half.

A publication relating to the expedition, issued recently by G. P. Putnam's Sons, New York, stands peculiarly and uniquely alone. The author, Mr. Olin D. Wheeler, is well known as the writer of the popular Wonderland series of the Northern Pacific Railway, in connection with which he made his studies and researches for this more pretentious work.

Mr. Wheeler has traveled several thousand miles over the old route of Lewis and Clarke, on railway trains and steamboats, in rowboats, afoot, on horseback, and in buggies or wagons. He has traveled with pack trains, camped out, and climbed mountains, in following the old Indian trails that the explorers followed and in visiting remote points made memorable by them. He has sojourned among Indian tribes, some of them now almost extinct, that Lewis and Clarke visited, and he has talked with one old squaw who, as a child, saw Lewis and Clarke.

The explorer's route across the Bitter Root Mountains, from the headwaters of the Missouri River to the sources of the Snake River, and thence to the Kooskooske or Clearwater River, which has always been an unsolved problem, full of uncertainties and gaps, has been carefully followed and completely solved and mapped.

"The Trail of Lewis and Clarke" is illustrated in color and half tone from paintings, drawings, and maps made under Mr. Wheeler's direction, and from photographs taken by professional photographers who accompanied him for the purpose.

The original manuscript journals of Lewis and Clarke were studied by the author, and exact excerpts and photographic reproductions, in half tone, of their pages and drawings are given.

The Louisiana Purchase Exposition at St. Louis, and the Lewis and Clarke Centennial, to be held at Portland, Oregon, in 1905, to commemorate the great exploration itself, make this work by Mr. Wheeler peculiarly timely and apropos, because it is written by the only person who, from actual travel over, and investigation of, the Lewis and Clarke route, can write from the standpoint of actual knowledge of past and present conditions of the old trail and country.

Bulletin of the Michigan Ornithological Club. Published by the Club, at Detroit, Mich., quarterly.

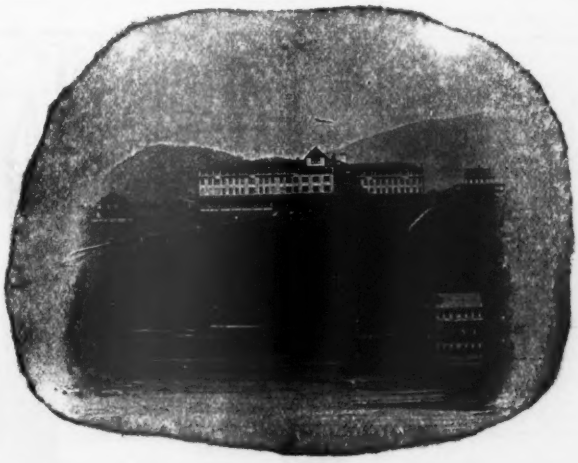
The first issue of this bulletin for the present year is a most creditable one, and should be seen by every ornithologist in the country for its three articles on Kirtland's warbler, one of the rarest and most interesting of all American birds. The writers have each taken a different phase of the bird's life, so that the trio of essays is complete and adds much to the present knowledge of this warbler and its habits. For careful editing this bulletin is to be especially commended.

NEW MEMBERS OF THE AMERICAN FORESTRY ASSOCIATION.

The following-named persons have joined the American Forestry Association since our May issue:

Bancroft, William P., Wilmington, Del.
Barstow, Dr. J. W., Vergennes, Vt.
Bullard, Henry W., Cambridgeport, Mass.
Burdett, Glencarlyn, Va.
Bush, Walker D., Wilmington, Del.
Butler, Charles S., 52 Wall street, New York City.
Chase, Lewis, Rochester, N. Y.
Clossett and Denvers, Portland, Oregon.
Davis, James Sherlock, Grand street and Gardner avenue, Brooklyn, N. Y.
Delameter, D. C., 487 Third street, Detroit, Mich.
Dickinson, La Fell, Ashuelot, N. H.
Donnell, William C., Houlton, Maine.
Dow, D. Webster, 121 Beverly street, Boston, Mass.
Dunn, W. H., 211 East Broad street, Richmond, Va.
du Pont, H. A., Winterthur, Del.
du Pont, T. C., Wilmington, Del
Earle, Samuel C., 9 Electric avenue, West Sommerville, Mass.
Fish, Mrs. Clara P. (*Sustaining member*), Prescott street, Longwood, Mass.
Fisk, Harvey Edward, 35 Cedar street, New York City.
Harris, John L., care of Metcalf Shingle Co., Kelso, Wash.
Hawks, James D., 999 Jefferson avenue, Detroit, Mich.
Hoffman, Mrs. Catherine A., Enterprise, Kans.
Jordan, Frank M., Montfort, Que., Canada.
Kent, Henry O., Lancaster, N. H.
Lane, Mrs Louisa G., 380 Washington street, Norwich, Conn.
Lindsay, James, Paia, H. T.
Malcom, Arthur, Bethlehem, N. H.
Malcom, Mrs Amelia V., Bethlehem, N. H.
Miller, Mrs. Ida Farr, Wakefield, Mass.
Mumford, N. W., 26 Wilder arcade, Rochester, N. Y.
Myrick, Herbert, Springfield, Mass.
Palmer, Honore, 77 East Jackson boulevard, Chicago, Ill.
Pauls, Gustavus, The Altenheim, St. Louis, Mo.
Pereles, Judge ——, Milwaukee, Wis.
Pereles, Hon. F. J., Milwaukee, Wis.
Rowe, Henry C., 490 Orange street, New Haven, Conn.
Runk, Mrs. Emma T. B., Lambertville, N. J.
Wayland, Mrs. Francis, 175 Whitney avenue, New Haven, Conn.
Withington, Hon D. L., Honolulu, H. T.
Wright, John G., 620 Atlantic avenue, Boston, Mass.

THE GRAND VIEW



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The salaries of Foresters, Assistant Foresters, Inspectors, and Assistant Inspectors range from $1,200 to $2,400 per year. Actual and necessary traveling expenses to and from the scene of field work are allowed, and while in the field one dollar gold per day is allowed for subsistence.

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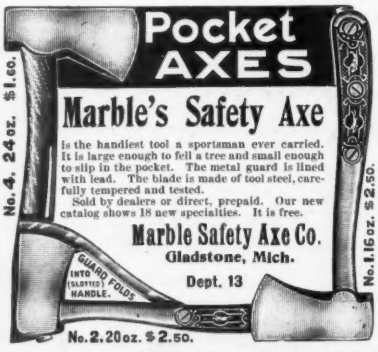
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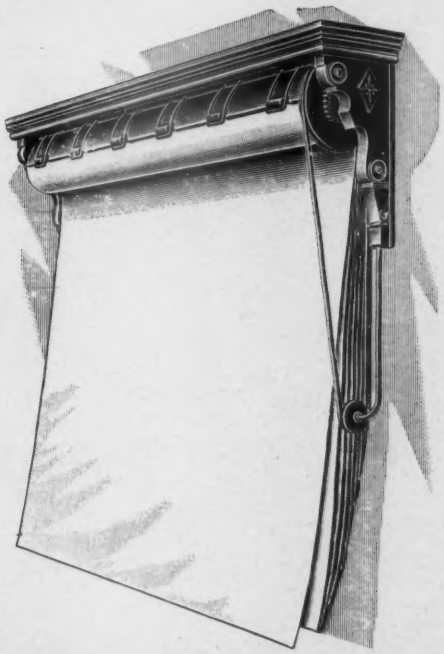

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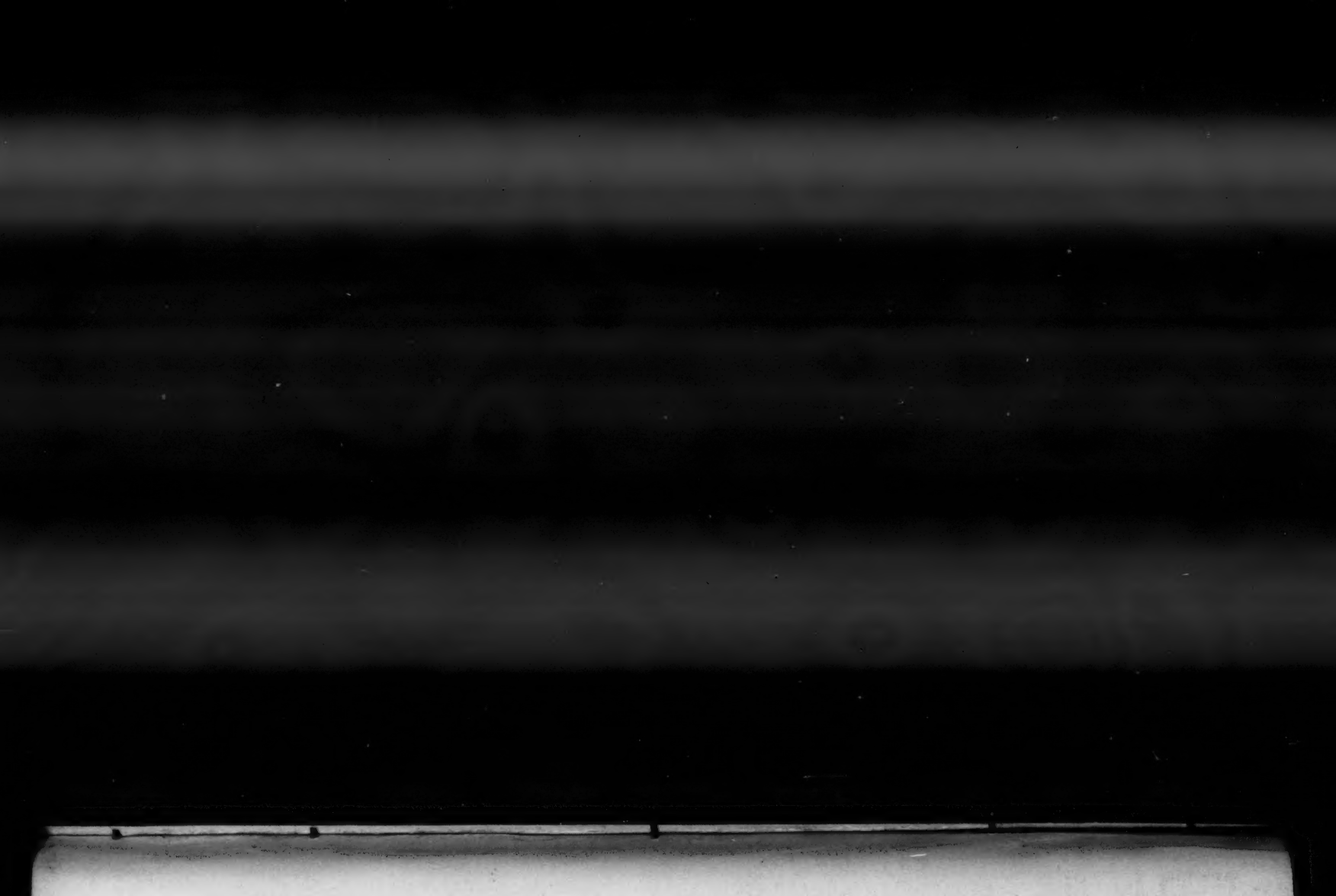
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